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REPORT RESUMES

ED 002 762 24
COMPARATIVE STUDIES OF SOME LEARNING CHARACTERISTICS IN MENTALLY RETARDED AND NORMAL CHILDREN OF THE SAME MENTAL AGE.
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REPORT NUMBER CRP-091 PUB DATE 58
CONTRACT OEC-SAE-6416
EDRS PRICE MF-$0.27 HC-$6.88 172P.

DESCRIPTORS- *LEARNING, *RETARDED CHILDREN, *COMPARATIVE ANALYSIS, *COMPARATIVE TESTING, *ELEMENTARY GRADES, CHILDREN, NEW YORK, SYRACUSE

INFORMATION WAS OBTAINED CONCERNING BASIC LEARNING CHARACTERISTICS OF RETARDED CHILDREN USING, INSOFAR AS POSSIBLE, MATERIALS WITH WHICH THEY HAVE HAD LITTLE OR NO PREVIOUS FAMILIARITY. THIRTY MENTALLY RETARDED AND AN EQUAL NUMBER OF NORMAL CHILDREN RANGING FROM 8 TO 9 YEARS IN MENTAL AGE WERE THE SUBJECTS OF THE STUDY. STANDARDIZED LISTS OF NONSENSE SYLLABLES, TESTS INVOLVING CANCELLATION OF SELECTED NUMBERS IN A SERIES OF SIX-PLACE NUMBERS, ASSEMBLY TASKS, AND OBJECT, PICTURE, AND WORD PROBLEMS OF REASONING, WERE GIVEN TO EACH SUBJECT. THE DATA WERE ANALYZED THROUGH STANDARD STATISTICAL ANALYSES OF DIFFERENCES BETWEEN GROUPS, AND INDIVIDUAL DATA SHEETS WERE ANALYZED AND CHARTED TO NOTE INDIVIDUAL SIMILARITIES AND DIFFERENCES. IT WAS CONCLUDED THAT THE LEARNING RATE OF MENTALLY HANDICAPPED CHILDREN IS AT LEAST EQUAL TO THAT OF NORMAL CHILDREN OF THE SAME MENTAL AGE OR DEVELOPMENTAL LEVEL. THUS A GROUP OF MENTALLY HANDICAPPED CHILDREN WILL BE ABLE TO LEARN SPECIFIC SKILLS AT THAT DEVELOPMENTAL LEVEL AT LEAST EQUALLY WELL AND WITH EQUAL RAPIDITY. HOWEVER, IT WILL TAKE THE MENTALLY HANDICAPPED GROUP APPROXIMATELY 1-1/2 YEARS TO DEVELOP INTELLECTUALLY THE SAME AMOUNT NORMAL CHILDREN WILL DEVELOP IN 1 YEAR. THE PRESENT SERIES OF STUDIES WAS LARGELY THEORETICAL IN NATURE AND SHOULD BE FOLLOWED UP WITH A PARALLEL SERIES CONCERNED WITH TASKS INVOLVING ACADEMIC LEARNING. (GC)

ED002762

COMPARATIVE STUDIES OF SOME LEARNING CHARACTERISTICS IN MENTALLY RETARDED AND NORMAL CHILDREN OF THE SAME MENTAL AGE.

I. LEARNING, RECOGNITION, RECALL, AND SAVINGS
II. PROACTIVE AND RETROACTIVE INHIBITION
III. GENERALIZATION
IV. REASONING

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December 1, 1956 - August 31, 1958

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The research reported herein was performed pursuant to
Contract SAE-6416 with the United States
Office of Education, Department of
Health, Education, and Welfare.

1958

ACKNOWLEDGEMENTS

The project director is very appreciative of the assistance provided by many persons in the University and the Public Schools, without whose aid it would have been impossible to carry out the project. Among the University personnel who contributed most are the graduate assistants, James Beaber, Leon Charney, A. Pappanikou, and Donald Smith, who aided in the design of some of the tasks and were largely responsible for the collection and tabulation of the raw data. Dr. Kathryn A. Blake was especially helpful, providing a great deal of assistance in statistical design and direction of some of the analyses as well as criticism of the manuscript. Mr. Beaber was also most helpful in carrying out much of the statistical analysis with the aid of Mr. Smith on certain parts.

Many persons in the Public Schools were most helpful in providing opportunities to work in their schools, setting aside testing rooms, and aiding with the obtaining of both mentally handicapped and normal subjects. The following are teachers and administrators who were especially helpful:

Mrs. John Ward, Principal, Heman School, East Syracuse; Dr. Frank Mosher, Superintendent, Liverpool Public Schools; Mr. Daniel Birecree, Supervisor of Special Education, Tully Public Schools; Mrs. Fern Charlton, Director of Special Education, Schenectady Public Schools; Miss Engels, Mrs. Lindsey, Mrs. Boland, Mrs. Lynch, Mrs. DuPlesis, Miss Giambrone, Mr. Yerkonis, Mr. Lent, Miss Fabrizio, Mr. McClure, Mrs. Gilson, Mrs. Wittbeck, Mrs. DeFeo, Mrs. Bird, Mr. Allen, and Mrs. Dulesky.

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INTRODUCTION

A curriculum planned for mentally handicapped children must take into account, among other things, the psychological characteristics of the children. A knowledge of the psychological characteristics, particularly the learning characteristics, is also essential in selecting the methods that will best develop the understandings and insure the acquisition of the information the teacher desires to impart. Thus, until greater knowledge concerning the learning characteristics of mentally handicapped children is available, educators will remain in the position in which the pioneers in the field (Itard, Sequin, Montessori, Decroly, and others) found themselves. Their programs were essentially based upon the philosophy they believed with little foundation of scientific fact and information. Binet was probably the first educator to attempt to solve the problems of curriculum and method using a scientific approach.

Relatively recent writings in the field are replete with dogmatic statements concerning the psychological characteristics of the mentally handicapped with little or no supporting evidence. Baker states,

> Mental characteristics show many features unique to the mentally retarded. In addition to the gross retardation in terms of mental age, there are many qualitative psychological ways in which they are backward, as follows: They show a tendency to stereotyped answers by repeating the same response to different questions; they lack power of self-criticism; their power of association is limited; they are unable to keep unusual instructions in mind, but return to traditional methods; they fail to detect error and absurdities in statements and in commonplace situations; they tend to have concrete abilities rather than abstract; they have limited powers of reasoning, visualization, and

> similar mental traits. A well-trained psychologist is able to form a good estimate of the brightness or dullness of any individual from the type of responses without computing the actual I.Q.[1]

Similar statements concerning interest, judgment, and learning ability may also be found in a number of places. Regarding interest, Tredgold says the "...range of interests, and consequently the number of things they can attend to, is decidedly limited, and of aments in general, even the mildest, it may be said that their interests are relatively few and their ability to attend much less than in the normal."[2] Garrison, discussing learning ability, reports, "The differences in the learning ability of those classed as mentally retarded and the average child is most pronounced in those activities that involve reasoning and problem solving in which symbols are used."[3] Duncan, in discussing observations of the children in the Lankhills School, reports along a somewhat similar line:

> Our investigations into the abilities of so-called mentally defective children reveal a deficiency of verbal ability much more marked than the deficiency in general ability. In general ability exercised through verbal channels and in abstract situations (i.e., in I.Q.) these children are of course among the poorest 3% or so of the population. In general ability exercised in real situations dealing with the relationships of things that can be seen or handled they are, on the average, approximately at the same level as children of middle ability.[4]

Finally, concerning judgment, Scheidemann states, "Judgment, the capstone of reasoning, is not encountered in any type of feebleminded."[5]

Most of these statements and comments concerning the behavioral characteristics of retarded persons were made on the basis of subjective observations of individuals or selected groups. Little research was available or engaged in to further the development of a more scientific understanding of these children. What small impetus Binet had provided to a scientific approach to the problem was apparently largely ignored.

Among the more recent writers, Ingram's statement concerning the learning potential of mentally handicapped children reflects a more scientific approach in that use was made of some available data and information regarding the child although all of the assumptions were not supported by research.

> Mental age and I.Q. suggest the limitations of the retarded child's abilities of association, comparison, comprehension, generalization, and symbolization compared with those of other children. For example, in school tasks calling for association, comprehension, and judgment - such as getting meaning from the printed page, adding new words to his vocabulary, and solving problems in number - the mentally retarded child who is chronologically twelve years old and mentally eight and a half years, with an I.Q. of 70, will respond more as the average eight-year-old child rather than as the average child of his own chronological age would. This principle generally holds true at all ages. Among the higher age groups long life experience and other favorable conditions may aid some individuals in succeeding better than their mental ages would suggest.[6]

As more careful observations were made, a number of persons came to recognize that the retarded did not make up a unique, homogeneous group that could be easily described or classified. An example of this more individualized approach to the problem is found in some of the earlier writings of Wallin:

> ...feeble-mindedness, instead of being a simple classificatory...entity due to a constant specific cause with definitely restricted and invariable symptoms..., is a highly complex condition, complex in respect to the fact that it may affect in unequal degree various functions, physical, intellectual, instinctual, volitional, emotional, social, and moral; in that it may cover a wide range of defect from profound idiocy to a high-grade feeble-mindedness; in that it may be caused by a great variety of etiological factors...[7]

Following somewhat the same line of thought as Ingram, Kirk makes two statements and follows them with a very pertinent question:

> All studies and observations show that the mentally deficient learn more slowly and retain less than normal children. There is no question on this point. A related question is: How do the mentally deficient compare in learning ability with normal children of the same mental age? That is, will a child of twelve whose mental age is six learn as rapidly as an average child of six years?[8]

The above statements, and others similar to them, taken either in their entirety or (as has been so often the case) out of their context, have been responsible for the many cliches so glibly spoken when referring to the characteristics of mentally handicapped children. Only the careful student has been fully aware of the limitations placed on some of these statements by their original authors. In addition, since the total area of the mentally retarded encompasses a wide variety of characteristics and abilities, only by detailed reading of the complete text can one be sure of the specific group (the slow learner, the mentally handicapped, or the mentally deficient) with whom the author is concerned. The lack of agreement concerning terminology is one of the major reasons for the entire problem since true statements concerning one population may be entirely inaccurate when applied to another.

FOOTNOTES

1. Baker, H. J., Introduction to Exceptional Children, Revised Edition, New York: The Macmillan Co., (1953), pp. 258-9.

2. Tredgold, A. F., A Textbook of Mental Deficiency, Sixth Edition, Baltimore: William Wood and Co., (1937), p. 99.

3. Garrison, K. C., The Psychology of Exceptional Children, New York: The Ronald Press Co., (1950), p. 131.

4. Duncan, J., The Education of the Ordinary Child, New York: The Ronald Press Co., (1943), p. 55.

5. Scheidemann, N. V., The Psychology of Exceptional Children, Boston: Houghton-Mifflin Co., (1931), pp. 58-9.

6. Ingram, C. P., Education of the Slow-Learning Child, Second Edition, New York: The Ronald Press Co., (1953), pp. 15-16.

7. Wallin, J. E. W., The Education of Handicapped Children, Boston: Houghton-Mifflin Co., (1924), pp. 58-9.

8. Kirk, S. A., Teaching Reading to Slow-Learning Children, Boston: Houghton-Mifflin Co., (1940), p. 9.

CHAPTER I

REVIEW OF RESEARCH

Lack of agreement concerning terminology is a major problem when attempting to review the research that has been completed in the area of mental retardation. The reviewer is not only faced with the problem of terminology, but also the defined populations differ in terms of coming from institutions or from public schools. In some instances of comparative studies, the retarded population has come from an institution while the normal group has been selected from public schools. In other instances both groups may come from institutions or from public schools. Inasmuch as such factors as dependency, delinquency, lack of social and emotional adjustment, and so forth, enter into the causes for institutionalization for both mentally handicapped and normal children, the influence of these factors upon the children's performance must also be taken into account.

Research in the area of mental retardation in the last decade has been characterized by increased interest in experimental endeavors designed to provide further information regarding the learning characteristics of the mentally retarded. Writing in 1948, McPherson[1] undertook an extensive review of published research in this area. Fourteen studies were reported representing the totality of research in the area of the learning characteristics of the retarded at that time. Since that writing, a review of the literature reveals fourteen additional published studies concerned with this topic.

Standard intelligence tests are ordinarily considered to demonstrate the existence of quantitative differences in the intelligence of retarded children when compared to normal children of the same chronological age. These quantitative differences have often been the bases for the development of specialized curriculums and methodologies. There is, however, a lack of research concerned with the possibility that qualitative differences may be operative when comparisons are made between retarded and normal children of the same mental age.

Investigations which attempt to clarify the actuality of these qualitative differences are worthy of the efforts of research personnel. As indicated above, research findings in this area will, in the long run affect the activity of those interested in planning educational programs for the retarded. The following is a brief review of the literature summarizing those studies having direct bearing on various aspects of learning.

Cassell[2] reported research which attempted to assess qualitative differences in the verbal learning ability of retarded familial, retarded exogenous, and normal subjects of equivalent mental ages. The retarded familial group consisted of twenty-six white male institutionalized subjects. The groups were equated for mental age on the basis of the Chicago Non-Verbal Examination. The mean mental age of this group was 9.4 years, mean chronological age was 20.8 years.

The normal group consisted of twenty-six children with a mean mental age of 9.3 years, mean chronological age of 9.4 years. The subjects after practice using the anticipation method with three lists of highly familiar words, were required to learn an experimental list of six words presented on a memory drum. An interpolated list of five words was also presented on the memory drum to half the group in order to produce retroactive inhibition. The results revealed that although the practice lists were used only as devices to ascertain that the subjects understood the task, the normal group reached the criterion significantly faster than the retarded group. When presented with the experimental task, no significant differences were found between the groups. The results further indicated that although retroactive inhibition did obtain, no evidence of any significant difference between the groups was found.

Cruickshank and Blake[3] recently reported the results of a comparative study of the performance of mentally handicapped and intellectually normal boys on selected tasks involving learning and transfer. Thirty intellectually normal and thirty mentally handicapped boys were matched individually on the basis of mental ages within the range of 7 years 11 months to 11 years 8 months. The mean mental age of both groups was 10 years. The subjects were divided into experimental and control subgroups, which were compared in terms of mental age and chronological age. Three tasks were undertaken by the subjects. These tasks were designed to reflect sensorimotor learning, rote learning and the discovery and application of an underlying principle.

The rote learning task required that the subjects learn to associate three pairs of nonsense syllables presented on a memory drum, the method of paired associates being used. Transfer was measured by requiring the subjects to associate, by the same method, the original response syllables to modified stimulus syllables. The experimental groups were exposed to the learning series and the transfer series. The control groups received only the transfer series. The results indicated that the mean number of syllables correctly associated by the normal experimental subjects was significantly higher than the mean number associated by the mentally handicapped experimental subjects. Cruickshank and Blake noted, however, that the control groups did not show similar significant differences. Here the difference was significant between the .10 and .05 levels of probability. Subsequent analysis of the mean performance of the total normal and total mentally handicapped groups did indicate that the total groups differed significantly in terms of mean performance on the direct rote learning task. They concluded that the evidence seemed to indicate that intellectually normal subjects were "...probably superior to mentally handicapped subjects of comparable mental ages in direct rote learning performance as it is reflected by the paired associates task."[4]

McCulloch, Reswick and Roy[5] undertook an investigation of the abilities of mental defectives in a task involving repetitive learning. An attempt was made to analyze the relationship of chronological age and mental age to performance on a verbal task involving both one-trial learning and repetitive learning. Two groups of 36 subjects each were selected (on the basis of Binet mental age) from an institutionalized population. The groups were matched for chronological age; the mean mental ages of the two groups were 6.1 and 9.1 years, respectively. Comparisons were made between the two groups and between the younger and older members of the groups. The learning task was designed to reveal individual differences in ability to learn to make meaningful, verbal associations.

The results indicated that the group with the higher mean mental age excelled the group with the lower mean mental age on total scores, initial scores, and increment scores. There was no significant difference between the groups in respect to the ratio of initial score to increment score. When older and younger subjects of the same mental age were compared, it was found that their initial scores were equal. The younger group,however, significantly exceeded the older group in terms of increment.

In a second study, McCulloch, Reswick, and Weissmann[6] undertook to compare the results of the study reported above with performance on other tasks. The tasks utilized were the WISC and the Binet measured Grasp (one trial learning), scores of grasp on the Word Learning Task would correlate more highly with the tasks indicated above than would the repetitive learning scores. A group of 100 mental defectives was selected having a normal distribution of mental ages, around a mean of

8.4 years. Correlations were obtained for the results of the word learning test and the WISC, Binet, and digit tasks. These correlations tended to indirectly support the hypothesis that the Binet and the WISC correlated more highly with a measure of initial learning than with scores measuring increment with repetition.

Sloan and Berg[7] report research designed to investigate some methodological problems in the study of learning with mental defectives and to examine the relationship between word learning and maze learning. The Word Learning Test, used by McCulloch, a Maze Test, and the Binet were administered to 35 institutional retardates. The results confirmed the basic data reported by McCulloch. The authors report no significant relationship between maze learning and mental age.

Wilson[8] compared the progress made by four groups of bright and dull children of selected mental abilities and chronological ages in the learning of identical, novel tasks. Comparisons were made of the performances of bright and dull children with the same mental ages. One of the tasks involved memorizing the multiplication tables. Oral drill was conducted on each combination. Emphasis was placed upon immediate recall. Over a five day period each child was given a total of seven practice test trials and two retention tests. The difference in performance of the two groups in favor of the bright subjects was significant at the 5 percent level or less. Both groups showed improvement with practice. A second task required that the subjects memorize conventional short-hand symbols for 24 words. Over the period of five days there were seven practice periods and two retention tests.

The median performance of the bright subjects was again significantly higher than that of the dull at the 5 percent level or less. The learning curves indicated that both groups showed improvement. On a task requiring oral reproduction of the contents of a story, there was no significant difference in the performance of the two groups.

Tizard and Loos[9] conducted a study to determine how well imbeciles could succeed in carrying out a fairly complex laboratory task after practice. They also measured the amount of transfer to a similar task that took place. Eight imbeciles with a mean Binet I.Q. of 34.1 and an average chronological age of 20.4 years were trained on the Minnesota Spatial Relations Test. The authors reported considerable transfer of training and improvement with practice.

Woodrow[10], in one of the earliest studies reported, sought to determine how feebleminded children and normal children of the same mental age compared in terms of practice effects and transfer of training. He utilized four groups of subjects, retarded practice and control and normal practice and control. The four experimental tasks employed were a stick sorting test, sorting colored pegs, letter cancellation, and geometric form cancellation. The procedure consisted of initial and final testing of all groups on the experimental tasks with 13 days of interpolated practice on the form sorting task for the experimental groups. Woodrow concluded that there were no significant differences between the normal and retarded groups in terms of both absolute and percentage of improvement. He further concluded that both normal and retarded groups showed the same curve of practice effects. The retarded group showed more irregularity in improvement, but the difference in variability was not significant. He concluded that the normal and retarded did not differ in degree of transfer.

Colvin[11] sought to determine if there were any characteristic differences between the learning curves of normal and subnormal children. Five normal children were paired individually with 5 retarded children on the basis of mental age. Learning curves of performance on cancellation tasks were plotted. The normal children made greater improvement with less fluctuation than did the retardates. Colvin also studied the transfer performance of a pair of subjects. After training the children to cancel A's, he studied the speed with which they could cancel O's. He reported evidence of a marked degree of transfer on the part of the retarded subjects but much less transfer by the normal subjects.

Reynolds and Stacey[12] undertook a comparative study of the performances of normal and retarded subjects of different IQ levels on a mirror drawing task. Data reported on transfer of training, while not amenable to statistical analysis, indicated that the retardates showed improvement in performance as well as transfer of training. The percentages of transfer reported were 24 percent for the normal group, 21 percent for the retarded group. The authors also report that group variability was much more evident among the subnormal groups.

Cruickshank and Blake[13], in a second part of their study, hypothesized that mentally handicapped and normal subjects would not differ significantly in transfer of sensorimotor learning or transfer of a previously discovered principle. They further hypothesized that the variability of the mentally handicapped in the three types of transfer would not differ significantly. The findings were in support of the above hypotheses. No significant differences were found between the normal and mentally handicapped children of matched mental ages in either degree or variability of transfer.

McPherson[14] reported a study by Melhado[15] in which 28 mental defectives and six intellectually normal adults were required to learn to select the larger or smaller form in three parts of geometric designs and then to choose the reverse. He noted that the normals and retardates both solved the problem and generalized it, the former in fewer trials than the latter.

SUMMARY

McPherson, in a recent review of studies in the area of the learning characteristics of the retarded, concluded that:

> Those (studies) appearing to date are so heterogeneous that an inventory of the relationship between learning and mental deficiency is severely impeded. The various studies encompass diverse motivating techniques, emphasize various aspects of learning, utilize different methods of sampling and measuring acquisition, include subjects with variations in intellectual efficiency, and incorporate etiologically heterogeneous conditions...[16]

The above statement is equally applicable to the studies reviewed in this chapter. The studies by Cruickshank and Blake, Cassell, and McCulloch which have the closest bearing upon the present investigation of rote learning, utilized an institutionalized population for their retarded groups. This factor prevents generalizing from these studies to the population of retarded children who attend public school classes for the mentally handicapped. While Cruickshank and Blake concluded that the intellectually normal subjects are probably superior to mentally handicapped subjects of comparable mental ages in direct rote learning performance on a paired associates task, Cassell reported no significant differences between matched mental age groups in rote learning utilizing the anticipation method. Since different tasks were utilized in these studies, it is not possible to compare the results obtained. McCulloch found no significant differences between mental age groups when a ratio was obtained between initial and final score on a task involving repetitive learning. Wilson reported significant differences between bright and dull children of matched mental ages in the learning of identical novel tasks.

Studies concerned with differences between matched groups in degree of transfer of training (Tizard and Loos, Woodrow, Cruickshank and Blake, and Reynolds and Stacey), report no significant differences in this factor. Reynolds and Stacey reported greater group variability among the retarded than among the normal. Cruickshank and Blake, on the other hand, could find no significant differences in variability between their groups.

There is a decided lack of comparative research concerned with ascertaining whether differences in the reasoning process exist between retarded and normal children of the same mental age. The study by Melhado reported differences in the ability to generalize when 28 mental defectives were matched to six intellectually adequate adults.

In general, the above quoted comment by McPherson appears to be an accurate commentary on the present status of research concerned with the learning characteristics of the mentally retarded. As McPherson indicated:

> The above studies point to the need of more extensive and more adequately integrated experimental investigations.[17]

FOOTNOTES

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15. Melhado, J. J., "Irradiation and Generalization in Aments", Unpublished Master's Thesis, University of New Hampshire, 1947.

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17. McPherson, op. cit., p. 875.

CHAPTER II

GENERAL, DESCRIPTION, PURPOSES, AND HYPOTHESES

Mentally handicapped children are ordinarily selected for placement in a special class upon the basis of the results obtained from a single psychological instrument or intelligence test. State laws and regulations often limit the placement of children in special classes to those who obtain an IQ between 50 and 70 or 50 and 75, based upon the administration of an individual intelligence test. Despite the fact that educators and psychologists familiar with the problems of mental retardation recommend that placement be determined upon the basis of a more extensive psychological, physical, educational and social examination, relatively few states have seen fit to follow their recommendations or found ways to effectively and efficiently administer them.

Standard intelligence tests are ordinarily thought to measure quantitative aspects of intelligence primarily and thus demonstrate quantitative rather than qualitative differences in the intelligence of children. It is also recognized that different standard intelligence tests measure somewhat different things. The 1937 Revision of the Stanford-Binet, Form L, one of the more commonly used individual intelligence tests, is considered to be strongly weighted with verbal abilities.[1] Thus, it tends to measure the individual's ability to deal with verbal symbols and is one of the more accurate predictors of school success available. Other intelligence tests such as the Arthur Point Scale and Cornell Cox are performance tests that

seemingly measure more accurately how well an individual can do things. They are less accurate in predicting verbal facility and situations in which this is required.[2] Probably for these reasons, among others, the Stanford-Binet (a verbal intelligence test) and the Wechsler Scales (a combination verbal and performance test) are used most commonly when examining children suspected of being mentally handicapped for placement in special classes.

Since standard intelligence tests apparently demonstrated quantitative differences in intelligence primarily, many curriculums and methodologies developed, particularly in the past, have been planned primarily on this basis. While a well-trained psychologist can obtain indications of qualitative differences as well as a measure of intellectual levels of children on these and other standard intelligence tests, their observations have had relatively little effect upon the curriculums found in individual classes for mentally handicapped children.

Numerous persons have reported that mentally handicapped children have qualitative as well as quantitative differences in intelligence from normal children. Indications concerning qualitative differences have been supported indirectly by a few studies such as the ones done by Cruickshank[3,4] on arithmetic, and Dunn[5] on reading. These authors compared the arithmetic and reading abilities of mentally handicapped and normal boys. Whether or not the differences found by the authors were innate or due to factors involved in the instruction the children had received, as well as other background experiences of the subjects, could not be determined from these studies alone.

The following studies were designed to obtain information concerning some of the basic learning characteristics of mentally handicapped children as compared to normal children of the same mental age. A series of four studies were planned to measure some learning characteristics of children so that comparisons could be made. They were designed to obtain measures of: (1) Memorization, Recognition, Recall, and Savings; (2) Proactive and Retroactive Inhibition; (3) Ability to Generalize or apply a common principle to a unique task (Transfer); and (4) Reasoning.

DESCRIPTION OF GROUPS AND DEFINITION OF TERMS

Two major groups of children were used in each of the studies - normal and mentally handicapped.

Normal. The normal group consisted of all the children enrolled in the regular third and fourth grades of one public school located in a small suburban community. The community had also carefully surveyed their school population and all mentally handicapped children of this age level had been previously placed in a special class.

Mentally Handicapped. The mentally handicapped group consisted of children who were enrolled in special classes. These children had all been tested with an individual intelligence test prior to their placement in the special class and met the criteria for placement established by the New York State Department of Education. The majority of the mentally handicapped children had I.Q.'s on the Stanford-Binet between 50 and 75. Very few tested over 75, the highest being 78. Every mentally handicapped child who had not been tested on the Stanford-Binet within a year preceding the experiment by a qualified psychological examiner, or where there was some question concerning the results of previously administered Stanford-Binet tests, due to lack of agreement with previous results or lack of agreement with demonstrated achievement, a new test was administered prior to the inception of the study.

Memorization. Memorization was defined and measured in terms of the number of trials a child required to memorize a series of 6 nonsense syllables (Appendix A) to a criterion of two successively correct trials, using the anticipation method with a memory drum (Appendix B).

Recognition. Recognition was defined as the number of correct nonsense syllables a child could select when they were imbedded within a total of 72 nonsense syllables (Appendix C), 6 of the 72 being the ones that had been learned, the other 66 being syllables that were not contained in the original list used to test ability to memorize.

Recall. Recall was defined as the score or number of nonsense syllables a child could identify in serial order when the initial list of syllables was again presented on the memory drum one week after the initial and second memorization trials.

Savings. Savings was defined as the score or number fewer trials required to re-memorize the original list of 6 nonsense syllables one week after the original learning had taken place. A second savings score was also obtained when the original list was relearned two weeks after the original learning.

Proactive Inhibition. Proactive inhibition was defined as the effect that learning an initial task had on subsequent learning of a task of a similar nature.

Retroactive Inhibition. Retroactive inhibition was defined as the effect that learning an intervening task of a similar nature had on the individual's retention and completion of the learning of that task.

Generalization (Transfer of a Principle). The ability to generalize was defined as the ability of an individual to apply a learned principle to a unique task which the individual had not previously seen or with which he had had no previous specific experience.

Reasoning. Reasoning was defined as the ability to determine a principle as the result of trial and error experiences and then apply this principle to succeeding tasks of an identical nature.

HYPOTHESES TO BE TESTED

The major hypothesis to be tested in this series of learning studies was: There are no differences between the learning characteristics of normal and mentally handicapped groups of children of the same mental age. Following this, a number of additional hypotheses were postulated in reference to specific studies.

Memorization, Recognition, Recall, and Savings.

1. There are no differences between the Memorization characteristics of normal and mentally handicapped groups of children of the same mental age.
2. There are no differences between the Recognition characteristics of normal and mentally handicapped groups of children of the same mental age.
3. There are no differences between the Recall characteristics of normal and mentally handicapped groups of children of the same mental age.

4. There are no differences between the Savings characteristics of normal and mentally handicapped groups of children of the same mental age.

Proactive and Retroactive Inhibition

1. The learning of a second task will be affected by having previously learned an initial task of the same nature for normal children.
2. The learning of a second task will be affected by having previously learned an initial task of the same nature for mentally handicapped children.
3. There will be no differences concerning the affect of previous learnings on subsequent learnings between normal and mentally handicapped groups of children of the same mental age.
4. When the learning of a task is interrupted with the learning of a task of a similar nature, the completion of the learning of the original task will be affected in normal children.
5. When the learning of a task is interrupted with the learning of a task of a similar nature, the completion of the learning of the original task will be affected in mentally handicapped children.
6. There will be no differences concerning the affect of having the learning of a task interrupted with the learning of a task of a similar nature between normal and mentally handicapped groups of children of the same mental age.

Ability to Generalize (Transfer)

1. A group of normal children will be able to perform better on a unique task where a learned principle can be applied than a group of normal children of the same mental and chronological ages who have not had the principle taught to them.
2. A group of mentally handicapped children will be able to perform better on a unique task where a learned principle can be applied than a group of mentally handicapped children of the same mental and chronological ages who have not had the principle taught to them.
3. Normal and mentally handicapped groups of children of the same mental age will have the same ability to apply a common principle to a unique task (Transfer).

Reasoning

Normal and mentally handicapped groups of children of the same mental age will show the same ability to perform on a task in which they are required to reason or discover a principle.

FOOTNOTES

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CHAPTER III

MEMORIZATION, RECOGNITION, RECALL, AND SAVINGS

PROCEDURE

Thirty normal children and thirty mentally handicapped children were selected from regular and special classes to be used in the study (Table I). The chronological ages of the group of mentally handicapped children ranged from 135 to 203 months with a mean of 162.20 months as compared to a range of 102 to 132 months with a mean of 111.63 months for the group of normal children. The difference between the mean chronological ages of the two groups was 50.57 months. This difference was to be expected since the two groups were matched only in terms of mean mental age and sex.

TABLE I

MEANS AND DISTRIBUTIONS OF CHRONOLOGICAL AGES, MENTAL AGES, AND INTELLIGENCE QUOTIENTS OF THE MENTALLY HANDICAPPED AND NORMAL GROUPS USED IN MEMORIZATION, RECOGNITION, RECALL, AND SAVINGS STUDY

	MENTALLY HANDICAPPED			NORMAL					
	N	M	σ	N	M	σ	DIFF/M	t	PROBABILITY
C.A.	30	162.20 mo.	17.58	30	111.63 mo.	8.24	50.57 mo.	9.750	$<.001$
Range		(135-203 mo.			(102-132 mo.)				
M.A.	30	110.73 mo.	10.18	30	111.40 mo.	8.03	0.67 mo.	1.497	$>.05$
Range		(98-131 mo)			(94-132 mo.)				
I.Q.	30	70.00	4.81	30	100.43	10.53	30.43	6.584	$<.001$
Range		(61.76)			(80-119)				

The mental ages of the mentally handicapped children ranged from 98 to 131 months with a mean of 110.73 months as compared to a range of mental ages from 94 to 132 months for the normal children with a mean of 111.40 months. There was a difference of 0.67 months between the mental ages of the two groups, which was not statistically significant. The mean I.Q. of the mentally handicapped group was 70.00 with a range from 61 to 76. The mean I.Q. of the normal group was 100.43 with a range from 80 to 119.

A memory test, consisting of 6 nonsense syllables (NAF, PIM, TEV, MIB, YEK, BUP, Appendix A), was administered to each mentally handicapped and each normal child individually using a memory drum (Appendix B) with a one second exposure for each syllable. The anticipation method was used where the individual pronounced the first nonsense syllable when he saw a cue consisting of 3 stars, pronounced the second syllable when he was cued by seeing the first syllable, and so on through the series of 6 syllables. The series was presented in serial order until each child had memorized the complete series. The criterion used for learning the list of syllables was 2 successively correct repetitions. The number of repetitions required to memorize the series of syllables was tabulated for each child and recorded as Learning I Score.

One week later the children were given a test containing 72 nonsense syllables within which the 6 syllables that had been previously learned were imbedded (Appendix C). The children were requested to underline the syllables that they had learned the previous week. The number they had underlined correctly was tabulated and recorded as Recognition I Score. The syllables they underlined that were not included in the original learning series were recorded as Error I Score.

Following this, the 6 syllables were presented to the children again in serial order on the memory drum in the same way in which they had been presented the previous week. The score on the first repetition was recorded as Recall I Score and the number of repetitions required to relearn the series to the criterion of two successively correct repetitions was recorded as Learning II Score. The same procedure was repeated at the end of the second week thereby obtaining Recognition II Score, Error II Score, and Recall II Score. The total number of repetitions required to relearn the series of syllables to the same criterion of two successively correct repetitions for the third time was recorded as Learning III Score.

RESULTS

A comparison was made of the Learning Scores (number of repetitions), Recognition Scores, Error Scores, Recall Scores, and Savings (number fewer repetitions required on successive trials) of the mentally handicapped and normal groups.

Learning. When a comparison of the Learning Scores was made (Table II), it was found that the mentally handicapped children required an average of 18.70 repetitions to learn the 6 nonsense syllables (with a range from 10 to 27 repetitions) as compared to 22.20 repetitions (with a range from 8 to 40 repetitions) for the normal group on the first Learning Trial. Thus, the mentally handicapped

TABLE II

MEANS AND DISTRIBUTIONS OF LEARNING SCORES (NUMBER OF REPETITIONS) OF THE MENTALLY HANDICAPPED AND NORMAL GROUPS

LEARNING TRIAL	MENTALLY HANDICAPPED N	M	σ	NORMAL N	M	σ	DIFF/M	t	PROBA-BILITY
I	30	18.70	5.57	30	22.20	8.38	-3.50	1.300	>.05
Range		(10-27)			(8-40)				
II	30	6.57	3.26	30	6.30	4.32	0.27	0.209	>.05
Range		(3-15)			(2-26)				
III	30	3.67	1.29	30	4.83	2.00	-1.51	2.022	>.05
Range		(2-7)			(2-12)				

group learned the 6 nonsense syllables initially in an average of 3.50 less repetitions than the normal groups. The difference was not statistically significant.

The mean Learning II Scores obtained by the mentally handicapped and normal groups on their second trial a week later were 6.57 and 6.30, respectively. The range of scores, or repetitions, for the mentally handicapped was from 3 to 15 and for the normal from 2 to 26. The normal children relearned the 6 nonsense syllables on an average of 0.27 fewer repetitions than the mentally handicapped children. This difference was not statistically significant.

When the 6 nonsense syllables were presented for the third time a week later, the mentally handicapped group required an average of 3.67 repetitions (with a range from 2 to 7) to learn the 6 nonsense syllables to the criterion of 2 successively correct repetitions as compared to an average of 4.83 repetitions (with a range of from 2 to 12) for the normal group. The mentally handicapped group learned the nonsense syllables on the third trial with an average of 1.50 fewer repetitions than the normal group. The probability of this difference occurring by chance was not significant.

It was found that the mentally handicapped children learned the nonsense syllables on the first and third trials somewhat faster than the normal children, while the normal children learned the nonsense syllables slightly faster than the mentally handicapped children on the second trial. None of the differences was statistically significant.

Figures 1, 2, and 3 show graphically the learning characteristics of the mentally handicapped and normal groups studied on Learning Trials I, II, and III. An examination of Figure 1 shows clearly that the mentally handicapped children consistently recognized more nonsense syllables on each presentation, starting with the second repetition, than the normal children and continued to be superior until all the syllables were learned. All of the mentally handicapped children had achieved 2 successive correct repetitions by the thirty-first repetition of Trial I whereas 40 repetitions were required by the normal children to achieve the same level of learning.

Figure 2 shows the learning curves of the two groups for the Trial II. The normal children started initially with a higher score than the mentally handicapped children on the first repetition of the nonsense syllables and continued to be slightly superior, with the exception of the third and fifth repetitions, until the fourteenth and fifteenth repetitions when all of the mentally handicapped children

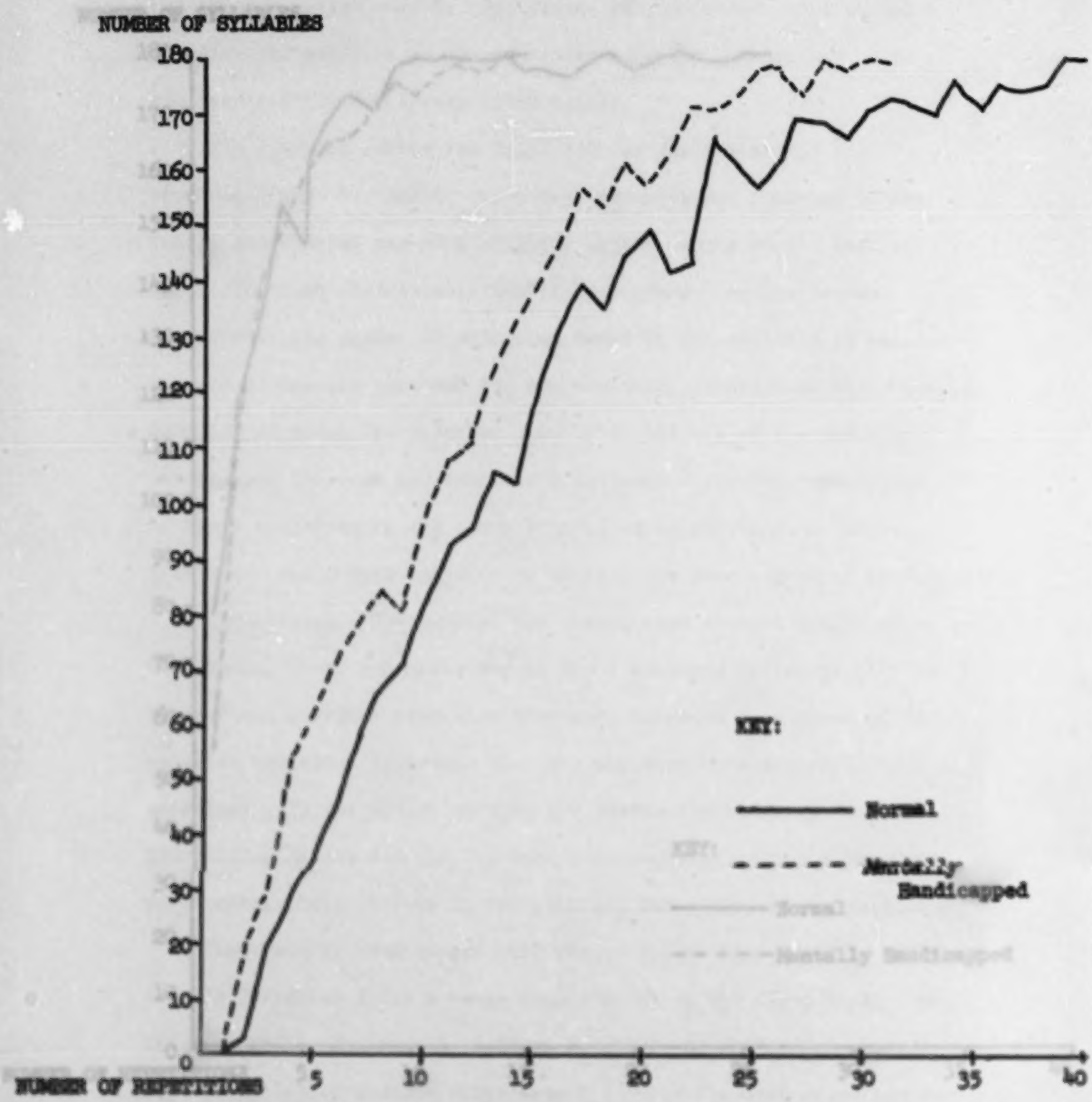

Figure 1

CURVES OF LEARNING FOR MENTALLY HANDICAPPED AND NORMAL CHILDREN.
LEARNING TRIAL I.

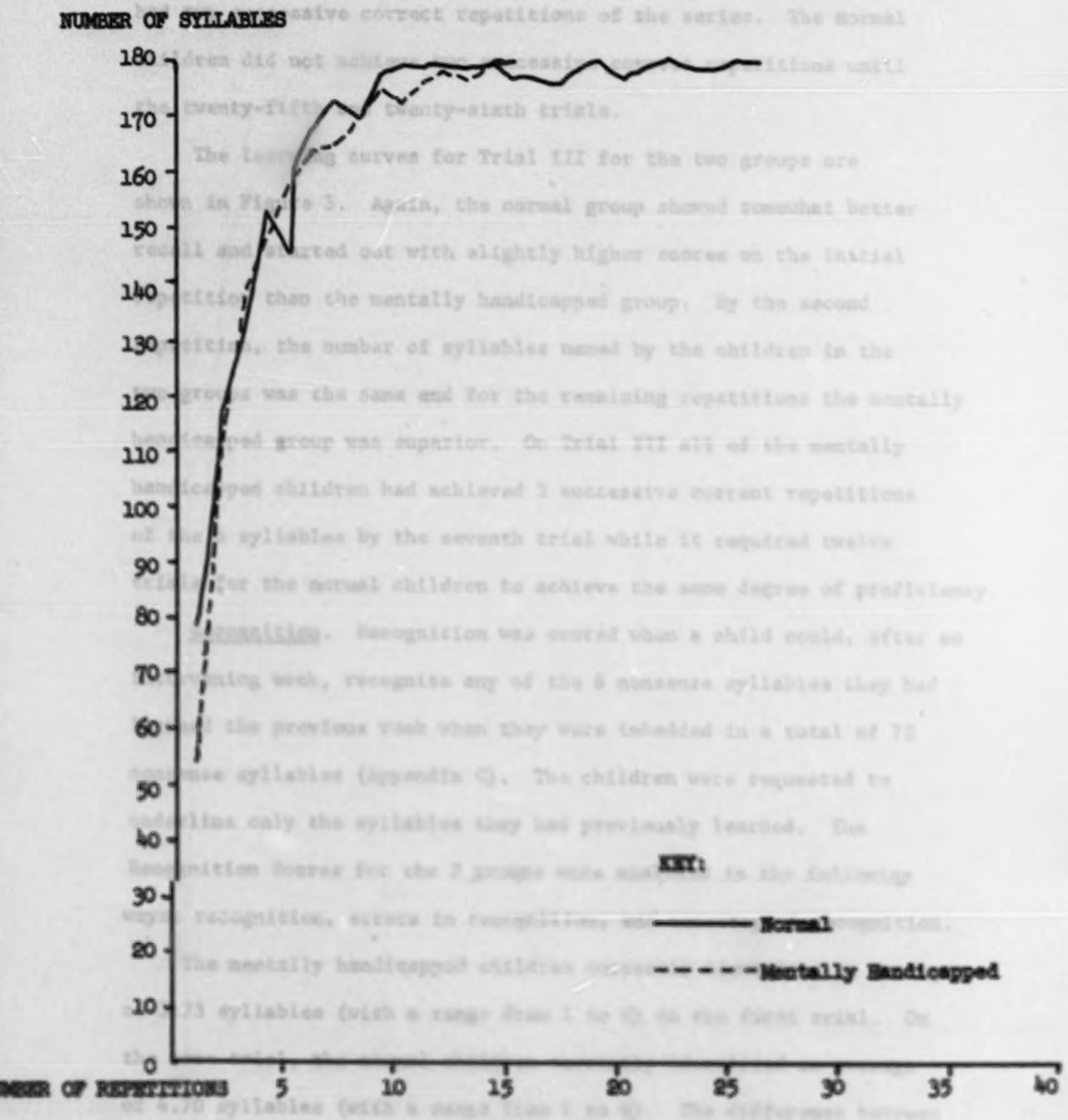

Figure 2

CURVES OF LEARNING FOR MENTALLY HANDICAPPED AND NORMAL CHILDREN.
LEARNING TRIAL II.

had two successive correct repetitions of the series. The normal children did not achieve two successive correct repetitions until the twenty-fifth and twenty-sixth trials.

The learning curves for Trial III for the two groups are shown in Figure 3. Again, the normal group showed somewhat better recall and started out with slightly higher scores on the initial repetition than the mentally handicapped group. By the second repetition, the number of syllables named by the children in the two groups was the same and for the remaining repetitions the mentally handicapped group was superior. On Trial III all of the mentally handicapped children had achieved 2 successive correct repetitions of the 6 syllables by the seventh trial while it required twelve trials for the normal children to achieve the same degree of proficiency.

Recognition. Recognition was scored when a child could, after an intervening week, recognize any of the 6 nonsense syllables they had learned the previous week when they were imbedded in a total of 72 nonsense syllables (Appendix C). The children were requested to underline only the syllables they had previously learned. The Recognition Scores for the 2 groups were analyzed in the following ways: recognition, errors in recognition, and accuracy of recognition.

The mentally handicapped children correctly identified an average of 3.73 syllables (with a range from 1 to 6) on the first trial. On the same trial, the normal children correctly identified an average of 4.70 syllables (with a range from 1 to 6). The difference between the mean scores of the two groups on Trial I was 0.97 syllables,

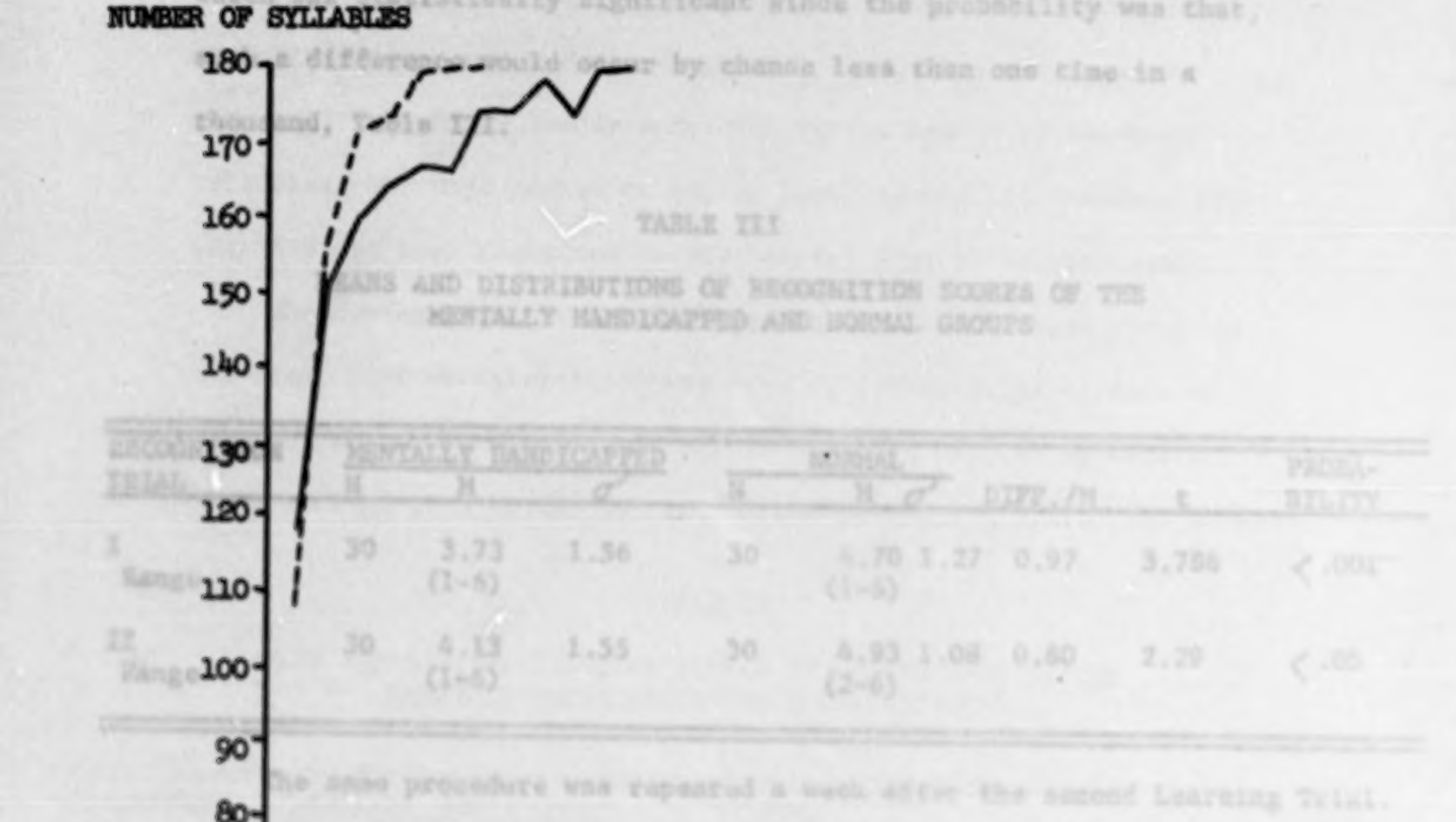

Figure 3

CURVES OF LEARNING FOR MENTALLY HANDICAPPED AND NORMAL CHILDREN.
LEARNING TRIAL III.

which was statistically significant since the probability was that such a difference would occur by chance less than one time in a thousand, Table III.

TABLE III

MEANS AND DISTRIBUTIONS OF RECOGNITION SCORES OF THE MENTALLY HANDICAPPED AND NORMAL GROUPS

RECOGNITION TRIAL	MENTALLY HANDICAPPED N	M	σ	NORMAL N	M	σ	DIFF./M	t	PROBABILITY
I	30	3.73	1.56	30	4.70	1.27	0.97	3.786	$<.001$
Range		(1-6)			(1-6)				
II	30	4.13	1.55	30	4.93	1.08	0.80	2.29	$<.05$
Range		(1-6)			(2-6)				

The same procedure was repeated a week after the second Learning Trial. The difference between the mean Recognition Scores of the two groups on the second recognition test was 0.80 syllables, which was statistically significant at the .05 level of confidence. Thus, the mean Recognition Score of the normal group was significantly greater than the mean Recognition Score of the mentally handicapped group a week after the initial learning and a week after the re-learning of the six nonsense syllables. The average second Recognition Score of the mentally handicapped group was 4.13 syllables (with a range from 1 to 6). The average second Recognition Score of the normal group was 4.93 syllables (with a range from 2 to 6). The difference between the mean recognition scores of the two groups on the second recognition test was 0.80 syllables, which was not statistically significant. Thus, the mean Recognition Score of the normal group was significantly greater than the mean Recognition Score of the mentally handicapped group a week after the initial learning of the 6 nonsense syllables.

Error. In addition to comparing the Recognition Scores of the mentally handicapped and normal groups, Error Scores were also compared. The Error Scores consisted of the number of nonsense syllables that were marked as having been learned the previous week that had not been contained in the initial list to be memorized.

The average Error Score for the mentally handicapped group on the first test of recognition was 3.63 syllables (with a range of 1 to 16) as compared to an average Error Score of 3.60 syllables (with a range of 0 to 15) for the normal group, Table IV. The normal group, on an average, made 0.03 less errors than the mentally handicapped group. This difference was not statistically significant. During the second recognition test, the mentally handicapped children made an average of 2.77 errors (with a range of 0 to 10) while the normal children made an average of 2.27 errors (with a range of 0 to 9). The difference between the mean errors of the two groups was 0.50 errors, again in favor of the normal group. This difference was not statistically significant either.

TABLE IV

MEANS AND DISTRIBUTIONS OF NUMBER OF ERRORS MADE BY THE MENTALLY HANDICAPPED AND NORMAL GROUPS

COGNITION	MENTALLY HANDICAPPED			NORMAL					PROBA-
IAL	N	M	σ	N	M	σ	DIFF./M	t	BILITY
ange	30	3.63 (1-16)	3.17	30	3.60 (0-15)	3.22	0.03	0.035	>.05
ange	30	2.77 (0-10)	2.37	30	2.27 (0-9)	2.50	0.50	0.078	>.05

Accuracy of Recognition. It was felt that neither the Recognition Scores nor the Error Scores, when analyzed separately, gave a complete or accurate description of the recognition abilities of the mentally handicapped or normal groups. It would have been, for example, possible for a child to receive a maximum Recognition Score of six if he had marked every syllable - at the same time, having 66 incorrect responses. Similarly, it did not seem that the Error Score alone gave a correct indication of the guessing that occurred since two children having the same number of errors might well have different numbers of correct responses. As a result, an Accuracy of Recognition Score was devised.

The Accuracy of Recognition Score was based upon 100. The subject received 16.67 points for each of the six syllables correctly identified for a maximum score of 100. Since there was 66 possible incorrect responses, each incorrect syllable was given a negative value of 1.52. The value calculated for the incorrect responses was subtracted from the value calculated for the correct responses for each Accuracy of Recognition Score.

The mean Accuracy of Recognition Score (Table V), for the mentally handicapped group at the end of the first week was 56.60 (with a range from 8 to 98) as compared to a mean score of 72.63 (with a range from 3 to 100), for the normal group. The difference between the two groups was 16.03. The probability of a difference of this size occurring by chance is between the 1 and 5 percent level of confidence.

TABLE V

MEANS AND DISTRIBUTIONS OF ACCURACY OF RECOGNITION SCORES OF THE MENTALLY HANDICAPPED AND NORMAL GROUPS

RECOGNITION	MENTALLY HANDICAPPED			NORMAL					PROBA-
TRIAL	N	M	σ	N	M	σ	DIFF./M	t	BILITY
I	30	56.60	26.58	30	72.63	22.68	16.03	2.481	< .05
Range		(8-98)			(3-100)				
II	30	64.53	27.85	30	78.40	20.33	13.87	2.177	< .05
Range		(8-100)			(22-100)				

Both the mentally handicapped and normal groups improved their mean Accuracy of Recognition Scores following the second week. The mean score for the mentally handicapped group at that time was 64.53 (with a range from 8 to 100) and for the normal group 78.40 (with a range from 22 to 100). Again the difference (13.87) was at the probability level between 1 and 5 percent.

Recall. The Recall Score consisted of the number of syllables correctly recalled during the first repetition of the 6 nonsense syllables during Learning Trial II and Learning Trial III. The mentally handicapped children recalled an average of 1.83 syllables (with a range of 0 to 6), Table VI, during the first repetition of the 6 nonsense syllables on Learning Trial II. The normal children recalled an average of 2.57 syllables (with a range of 0 to 6). The difference between the mean Recall Scores of the two groups was 0.74 syllables which was not statistically significant. When recall was tested on Learning Trial III of the 6 nonsense syllables to measure

TABLE VI

MEANS AND DISTRIBUTIONS OF RECALL SCORES OF THE MENTALLY HANDICAPPED AND NORMAL GROUPS

RECALL	MENTALLY HANDICAPPED			NORMAL					PROBA-
TRIAL	N	M	σ	N	M	σ	DIFF./M	t	BILITY
I	30	1.83	1.58	30	2.57	1.94	0.74	1.590	>.05
Range		(0-6)			(0-6)				
II	30	3.63	1.95	30	3.90	1.96	0.27	0.528	>.05
Range		(0-6)			(0-6)				

the recall that occurred as a result of the learning that had taken place during the first and second learning trials, it was found that the mentally handicapped children recalled an average of 3.63 syllables correctly on the first repetition of Learning Trials III (with a range of 0 to 6) as compared to an average recall of 3.90 syllables (with a range of 0 to 6) for the normal group. The difference between the means was 0.27 syllables, which was not statistically significant.

Savings. Savings Scores consisted of the differences between the number of repetitions required on initial and subsequent learning trials. Thus, the Savings Scores were calculated by subtracting the number of repetitions required on Learning Trial II from the number required on Learning Trial I, the number of repetitions required on Learning Trial III from the number required on Learning Trial II, and the number of repetitions required on Learning Trial III from the number required on Learning Trial I. Table VII is a summary of the analysis of the savings data. The mean Savings Score for the mentally

TABLE VII

MEANS AND DISTRIBUTIONS OF SAVINGS SCORES FOR THE MENTALLY HANDICAPPED AND NORMAL GROUPS

LEARNING TRIAL	MENTALLY HANDICAPPED			NORMAL					PROBA-BILITY
	N	M	σ	N	M	σ	DIFF./M	t	
I - II Range	30	12.13 (1-23)	6.02	30	15.90 (3-34)	8.19	-3.77	2.038	>.05
II - III Range	30	2.90 (-3-13)	3.41	30	1.80 (-5-18)	3.94	1.10	1.160	>.05
I - III Range	30	15.03 (6-28)	5.44	30	17.37 (5-35)	7.96	-2.34	1.315	>.05

handicapped group between Learning Trials I and II was 12.13 repetitions (with a range from 1 to 23) as compared to a mean Savings Score for the normal group of 15.90 repetitions (with a range from 3 to 34). The normal group saved, on an average, 3.77 more repetitions in relearning the 6 nonsense syllables on Learning Trial II as compared with Learning Trial I than the mentally handicapped group. This difference, however, was not statistically significant since the probability of a difference of this size occurring by chance is greater than the 5 percent level of confidence.

The mentally handicapped group saved an average of 2.90 repetitions (with a range from -3 to 13) between Learning Trials II and III as compared with a savings of 1.80 repetitions (with a range from -5 to 18) for the normal group. The savings for the mentally handicapped group between Learning Trials II and III was 1.10 repetitions greater than the savings measured for the normal group. This difference was not statistically significant.

When the Savings Scores between Learning Trials I and III were examined for the two groups, the mentally handicapped group showed an average savings of 15.03 repetitions while the normal group showed an average savings of 17.37 repetitions. The difference between the mean Savings Scores of the two groups of 2.34 repetitions was not statistically significant.

SUMMARY

Thirty normal and thirty mentally handicapped children were selected from regular and special classes for the study of Memorization, Recognition, Recall, and Savings. The two groups were equated for sex and mental age. The mean I.Q. of the mentally handicapped children was 70.00. The mean I.Q. of the normal children was 100.43.

Four hypotheses were to be tested. The first hypothesis was, "There are no differences between the Memorization characteristics of normal and mentally handicapped groups of children of the same mental age." The mentally handicapped children learned the 6 nonsense syllables in less repetitions than the normal children on Learning Trials I and III. The normal children learned the 6 nonsense syllables in fewer repetitions on Trial II. The differences, however, were not significant so that the hypothesis could not be rejected.

The second hypothesis to be tested was, "There are no differences between the Recognition characteristics of normal and mentally handicapped groups of children of the same mental age." Three tests were used - number of syllables recognized, number of errors, and accuracy of recognition. It was found that the normal children recognized a significantly larger number of syllables following both Learning Trial I and Learning Trial II than the mentally handicapped children. The mentally handicapped children made more errors than the normal children following both Learning Trials I and II. These differences were not significant. In testing for accuracy of recognition, where both the number of recognitions and number of errors made by each child were taken into account, it was found that the Accuracy of Recognition Scores of the normal children were superior to those of the mentally handicapped children and the differences were significant. Since only one-half of the scores tested were significant, the hypothesis could not be accepted or rejected.

The third hypothesis to be tested was, "There are no differences between the Recall characteristics of normal and mentally handicapped groups of children of the same mental age." It was found that the normal children recalled more syllables on the initial presentation of Learning Trials II and III than the mentally handicapped children. The differences between the means were not significant; therefore, the hypothesis could not be rejected.

The final hypothesis to be tested was, "There are no differences between the Savings characteristics of normal and mentally handicapped groups of children of the same mental age." Savings was tested between Learning Trials I and II, Learning Trials II and III, and Learning Trials I and III. It was found that the savings was greater for the normal children between Learning Trials I and II and Learning Trials I and III than for the mentally handicapped children. The savings was greater for the mentally handicapped children between Learning Trials II and III. None of the differences between the means was significant; thus, the hypothesis could not be rejected.

CHAPTER IV

PROACTIVE AND RETROACTIVE INHIBITION

PROCEDURE

Eighty normal children and eighty mentally handicapped children were selected from regular and special classes. These groups were then each divided into two subgroups of forty children (20 boys and 20 girls). Two of the subgroups were designated as control groups (normal and mentally handicapped) and the other two as experimental groups. A comparison of the chronological ages, mental ages, and intelligence quotients of the total, control, and experimental normal and mentally handicapped groups is summarized in Table VIII.

The groups were equated on the basis of mean mental ages obtained on the 1937 Revision of the Stanford-Binet, Form L. The mean mental age of the total normal group was 111.60 months with a range from 80 to 138 months. The mean mental age of the total mentally handicapped group was 110.83 months with a range from 88 to 135 months. The difference of 0.77 months between the mean mental ages of the two groups was not significant. The differences between the mean chronological ages (57.44 months) and intelligence quotients (35.82) were significant at less than the .001 level. The mean chronological age of the total normal group was 107.36 months (with a range from 94 to 132) as compared to a mean chronological age of 164.80 months (with a range from 131 to 194) for the total

TABLE VIII

MEANS AND DISTRIBUTIONS OF CHRONOLOGICAL AGES, MENTAL AGES AND INTELLIGENCE QUOTIENTS OF TOTAL, CONTROL, AND EXPERIMENTAL NORMAL AND MENTALLY HANDICAPPED GROUPS USED IN PROACTIVE AND RETROACTIVE INHIBITION STUDY

TOTAL GROUPS - N = 80

	NORMAL		MENTALLY HANDICAPPED				PROBA- BILITY
	M	σ	M	σ	DIFFERENCE	t	
C.A.	107.36 mo.	8.15	164.80 mo.	16.49	57.44 mo.	27.748	<.001
Range	(94-132)		(131-194)				
M.A.	111.60 mo.	13.05	110.83 mo.	11.17	0.77 mo.	0.402	>.05
Range	(80-138)		(88-135)				
I.Q.	104.43	12.83	68.60	5.10	35.82	23.019	<.001
Range	(79-135)		(52-75)				

CONTROL GROUPS - N = 40

	NORMAL		MENTALLY HANDICAPPED				PROBA- BILITY
	M		M		DIFFERENCE	t	
C.A.	108.60 mo.	8.71	163.63 mo.	18.19	55.03 mo.	17.036	<.001
Range	(97-127)		(131-194)				
M.A.	112.08 mo.	13.01	110.48 mo.	11.33	1.60 mo.	0.580	>.05
Range	(80-136)		(88-135)				
I.Q.	103.53	12.48	69.13	4.24	34.40	18.298	<.001
Range	(79-135)		(58-75)				

EXPERIMENTAL GROUPS - N = 40

	NORMAL		MENTALLY HANDICAPPED				PROBA- BILITY
	M		M		DIFFERENCE	t	
C.A.	106.13 mo.	7.34	165.98 mo.	14.50	59.85 mo.	23.113	<.001
Range	(94-132)		(140-190)				
M.A.	111.13 mo.	13.27	111.18 mo.	11.00	0.05	0.019	>.05
Range	(90-138)		(89-127)				
I.Q.	105.33	13.12	68.08	5.18	37.25	16.196	<.001
Range	(80-125)		(52-75)				

mentally handicapped group. The mean intelligence quotients were 104.43 (with a range from 79 to 135) and 68.60 (with a range from 52 to 75) for the total normal and mentally handicapped groups, respectively.

The mean chronological age of the normal control group was 108.60 months with a range from 97 to 127 months as compared to a mean chronological age of 163.63 months with a range from 131 to 194 months for the mentally handicapped control group. The difference between the mean chronological ages of the normal and mentally handicapped control groups was 55.03 months which was significant at less than the .001 level. A similar difference was also found between the chronological ages of the normal and mentally handicapped experimental groups. The mean chronological age for the normal experimental group was 106.13 months with a range from 94 to 132 months as compared to a mean chronological age of 165.98 months with a range from 140 to 190 months for the mentally handicapped experimental group. The difference between the mean chronological ages of the two groups was 59.85 months. This was significant at less than the .001 level of confidence.

The differences between the mean intelligence quotients of the control and experimental normal and mentally handicapped groups were 34.40 and 37.25,respectively. These differences were also significant at less than the .001 level of confidence.

In comparing the mental ages of the normal and mentally handicapped control and experimental groups, it will be noted that the normal children in each instance had a slightly wider distribution of mental ages than did the mentally handicapped groups, but the differences between the means were so small, 1.60 months and 0.05 months, that in neither instance were these differences found to be of any statistical significance. The mean mental age of the normal control group was 112.08 months (range from 80 to 136) and the mean mental age of the mentally handicapped control group was 110.48 months (range from 88 to 135). The mean mental ages of the normal and mentally handicapped experimental groups were 111.13 months and 111.18 months, respectively. The range of mental ages of the normal experimental group was from 90 to 138 months and for the mentally handicapped experimental group was from 89 to 127 months.

The differences between the mean intelligence quotients of the normal and mentally handicapped control and experimental groups were also significant at less than the .001 level of confidence. The mean intelligence quotient of the normal control group was 103.53 with a range from 79 to 135 while the mean intelligence quotient of the mentally handicapped group was 69.13 with a range from 58 to 75. The difference between the mean intelligence quotients of the two control groups was 34.40. The mean intelligence quotient of the normal experimental group was 105.33 with a range from 80 to 125. The mean intelligence quotient of the mentally handicapped experimental group was 68.08 with a range from 52 to 75. The difference between the two means was 37.25.

Table IX contains a summary of the data concerning the chronological ages, mental ages, and intelligence quotients of the normal control and experimental groups and the mentally handicapped control

TABLE IX

MEANS AND DISTRIBUTIONS OF CHRONOLOGICAL AGES, MENTAL AGES, AND INTELLIGENCE QUOTIENTS OF NORMAL AND MENTALLY HANDICAPPED CONTROL AND EXPERIMENTAL GROUPS USED IN PROACTIVE AND RETROACTIVE INHIBITION STUDY

NORMAL GROUPS - N = 40

	CONTROL		EXPERIMENTAL				
	M	σ	M	σ	DIFFERENCE	t	PROBABILITY
C.A.	108.60 mo.	8.71	106.13 mo.	7.34	2.47 mo.	1.360	>.05
Range	(97-127)		(94-132)				
M.A.	112.08 mo.	13.01	111.13 mo.	13.27	0.95 mo.	0.319	>.05
Range	(80-136)		(90-138)				
I.Q.	103.53	12.48	105.33	13.12	1.80	0.651	>.05
Range	(79-135)		(80-125)				

MENTALLY HANDICAPPED GROUPS - N = 40

	CONTROL		EXPERIMENTAL				
	M		M		DIFFERENCE	t	PROBABILITY
C.A.	163.63 mo.	18.19	165.98 mo.	14.50	2.35 mo.	0.632	>.05
Range	(131-194)		(140-190)				
M.A.	110.48 mo.	11.33	111.18 mo.	11.00	0.70 mo.	0.277	>.05
Range	(88-135)		(89-127)				
I.Q.	69.13	4.24	68.08	5.78	1.05	0.913	>.05
Range	(58-75)		(52-75)				

and experimental groups. An examination of this table will indicate that there were no statistically significant differences between the mean chronological ages, mental ages, and intelligence quotients of the normal control and experimental groups. The differences between the mean chronological ages, mental ages, and intelligence quotients for the normal control and experimental groups were 2.47 months, 0.95 months, and 1.80, respectively.

The differences between the mean chronological ages, mental ages, and intelligence quotients of the mentally handicapped control and experimental groups were 2.35 months, 0.70 months, and 1.05, respectively. None of these differences was significant.

The tasks to obtain measures of proactive and retroactive inhibition consisted of coding tests. The first nine letters of the alphabet were assigned a different number (1 through 9) on a random basis. The task was to write the correct number below the appropriate letter. The sequence of letters was also selected in a random fashion. The tasks were contained in three booklets consisting of an Original Task (Appendix D) presented twice and an Interpolated Task (Appendix E) presented once. The booklets containing the Original Task for Presentations I and II were identical except for the second page (a practice page used during Presentation I). The other booklet contained the Interpolated Task (Appendix E) that was used with the two experimental groups. The Interpolated Task was of the same nature as the Original Task except that it required the substitution of different numbers for the same letters.

The entire series of Tasks was administered to groups of fifteen or less children at a time during a single session. The time limit for each page was 45 seconds with 30 seconds being allowed for turning to the next page and briefly relaxing before continuing. The ten pages of the Original and Interpolated Tasks were done successively with no additional breaks than those previously mentioned for turning the pages. A ten minute break was given the experimental groups between Presentation I of the Original Task and the Interpolated Task, and again between the Interpolated Task and Presentation II of the Original Task. Presentation II of the Original Task consisted of 8 rather than 10 pages for some of the children due to circumstances beyond the control of the investigator (a fire drill in one of the schools). Consequently, only the first 8 pages of Presentation II of the Original Task were used in the analysis made throughout for all of the children.

The control groups took only Presentations I and II of the Original Task. The time used by the experimental groups in taking the Interpolated Task was devoted to listening to a story. Other phases of the tasks and their administration were identical.

Before startingPresentation I of the Original Task, a brief practice page was administered to each child, Figure 4. After each child had completed the practice page, his work was checked by the examiner to make sure that he knew how to do the task correctly. Thereafter, the children were told to turn to the next page and complete as many of the items as they could before being told to "Stop!" No additional

A	B	C	D	E	F	G	H	I
2	9	4	1	7	5	3	8	6

G	F	B	A	C	I	H	F	D

Figure 4

PRACTICE PAGE ADMINISTERED PRIOR TO PRESENTATION I
OF THE ORIGINAL TASK

practice pages were given for either the Interpolated Task for the experimental groups or Presentation II of the Original Task for any of the groups.

RESULTS

A trend analysis* was employed in order to determine whether it could be inferred that a significant increment in the scores occurred over the series of repetitions and to compare the displacement of the learning curves of the normal control and experimental groups and the mentally handicapped control and experimental groups. A summary of this analysis of the means of the scores obtained on each of the repetitions of the Original Task is contained in Tables X and XI.

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*E. F. Lindquist, Design and Analysis of Experiments in Psychology and Education, Boston: Houghton-Mifflin Co., 1953. pp. 267-73.

TABLE X

TREND ANALYSIS OF PERFORMANCE ON PRESENTATION I OF ORIGINAL TASK NORMAL CONTROL - NORMAL EXPERIMENTAL

SOURCE	df	SUM OF SQUARES	MEAN SQUARE	F	P
Total	abs-1 10x2x40-1=799	18,738.48			
Between Subjects	bs-1 2x40-1=79	11,877.68			
Between Groups	b-1 2-1=1	515.20	515.20	3.54	N.S.
Error (b)	bs-b 80-2=78	11,362.48	145.67		
Within Subjects	bs(a-1) 2(40)(10-1)=720	6,860.80			
A (Trials)	a-1 10-1=9	2,434.44	270.49	43.28	.001
AB (Trials x Groups)	(a-1)(b-1) 9x1=9	40.58	4.51	.72	N.S.
Error (w)	(a-1)(bs-b) 9x78=702	4,385.77	6.25		

TABLE XI

TREND ANALYSIS OF PERFORMANCE ON PRESENTATION I OF ORIGINAL TASK MENTALLY HANDICAPPED CONTROL - MENTALLY HANDICAPPED EXPERIMENTAL

SOURCE	df	SUM OF SQUARES	MEAN SQUARE	F	P
Total	abs-1 10x2x40-1=799	43,697.47			
Between Subjects	bs-1 2x40-1=79	23,433.61			
Between Groups	b-1 2-1=1	29.26	29.26	.097	N.S.
Error (b)	bs-b 80-2=78	23,404.35	300.06		
Within Subjects	bs(a-1) 2(40)(10-1)=720	20,263.86			
A (Trials)	a-1 10-1=9	4,712.24	523.58	23.70	.001
AB (Trials x Groups)	(a-1)(b-1) 9x1=9	45.61	5.07	.23	N.S.
Error (w)	(a-1)(bs-b) 9x78=702	15,506.01	22.09		

No difference was found between the displacement of the learning curves for the normal control and normal experimental groups (between groups F-ratio). The same was true for the mentally handicapped control and mentally handicapped experimental groups.

When the slope of the means of the separate trials of the groups was analyzed, significance between trials F-ratios were obtained. Thus, it was possible to reject the hypothesis that the slope of the trial means was zero at less than the .01 level of probability. On this basis, it can be inferred that a significant increment in performance over the series of repetitions took place in every case. That is to say, all four groups showed a significant amount of improvement with practice or learning. Finally, when the parallelness of the slopes of the learning curves of the normal control and experimental groups and for the mentally handicapped control and experimental groups was compared, the statistical evidence indicated that there was no significant difference between the groups in this respect.

Proactive Inhibition

Table XII shows a comparison of the differences between the number of correct items on the initial and eighth trials of Presentation I of the Original Task for the normal and mentally handicapped control and experimental groups. The average difference between the initial and final trials of the normal control group was 5.03. The range was from -4 to 13. The average difference between the initial and final trials of the normal experimental group was 4.48. The range was from -2 to 11. The difference between the means was 0.55.

TABLE XII

MEANS AND DISTRIBUTIONS OF DIFFERENCES BETWEEN NUMBER OF CORRECT ITEMS ON INITIAL AND EIGHTH TRIALS OF PRESENTATION I OF ORIGINAL TASK OF NORMAL AND MENTALLY HANDICAPPED CONTROL AND EXPERIMENTAL GROUPS

N = 40

	CONTROL		EXPERIMENTAL				
ROUP	M	σ	M	σ	DIFFERENCE	t	PROBA-BILITY
ormal	5.03	4.06	4.48	3.48	0.55	0.642	>.05
Range	(-4-13)		(-2-11)				
entally Handicapped	7.20	6.40	6.23	5.57	0.97	0.700	>.05
Range	(-1-23)		(-5-18)				

This difference was not significant. A slightly larger though non-significant difference was found between the mean differences between the initial and final trials for the mentally handicapped control and experimental groups. The difference between the means was 0.97. The average difference between the number of correct items on the initial and final trials for the mentally handicapped control group was 7.20, with a range from -1 to 23 and for the mentally handicapped experimental group 6.23, with a range from -5 to 18. Thus, there was no reason to suspect that there was any basic difference in the amount of learning that took place during Presentation I of the Original Task for either the normal control or experimental group or for the mentally handicapped control or experimental group.

When a comparison was made of the differences between the number of correct items on the initial and eighth trials of Presentation I of the Original Task for the normal and mentally handicapped control groups and the initial and eighth trials of the Interpolated Task for the experimental groups, it was found that the differences between the means in both instances were significant at less than the .001 level of confidence (Table XIII). Thus, assuming that the Original Task and Interpolated Task were of an identical nature and of equal difficulty, significantly less learning took place during the first 8 presentations of the Interpolated Task than tool place during the first 8 trials of the Original Task on Presentation I.

TABLE XIII

MEANS AND DISTRIBUTIONS OF DIFFERENCES BETWEEN NUMBER OF CORRECT ITEMS ON INITIAL AND EIGHTH TRIALS OF PRESENTATION I OF ORIGINAL TASK FOR NORMAL AND MENTALLY HANDICAPPED CONTROL GROUPS AND INITIAL AND EIGHTH TRIALS OF INTERPOLATED TASK FOR EXPERIMENTAL GROUPS
N = 40

ROUP	CONTROL		EXPERIMENTAL				
	M	σ	M	σ	DIFFERENCE	t	PROBA-BILITY
ormal Range	5.03 (-4-13)	4.06	2.00 (-4-14)	3.71	3.03	3.434	<.001
entally Handicapped Range	7.20 (-1-23)	6.40	3.08 (-7-13)	4.06	4.12	3.401	<.001

Because the Original Task and the Interpolated Task were of an identical nature, it could possibly be assumed that a sufficient amount of learning had taken place during Presentation I of the Original Task to the experimental groups that they were approaching their maximum scoring level and, therefore, less difference in learning could be expected from the initial to eighth trial on the Interpolated Task for the experimental groups than could be expected between the initial and final trial on Presentation I of the Original Task for the control groups. Consequently, comparisons were made of the differences between the number of correct items on the initial and eighth trials of Presentation II of the Original Task for the normal and mentally handicapped control groups and the initial and eighth trials of the Interpolated Task of the respective normal and mentally handicapped experimental groups (Table XIV). It was found that the mean gain in correct items for the normal control group was 4.83 with a range from -6 to 18,as compared to a mean gain of 2.00 with a range from -4 to 14 for the normal experimental group. The difference was 2.83, which was significant at less than the .01 level of confidence. A similar comparison of the mentally handicapped control and experimental groups indicated that the experimental group increased their average number of correct items 3.08, with a range from -7 to 13 on the Interpolated

TABLE XIV

MEANS AND DISTRIBUTIONS OF DIFFERENCES BETWEEN NUMBER OF CORRECT ITEMS ON INITIAL AND FINAL TRIALS OF PRESENTATION II OF ORIGINAL TASK AND INTERPOLATED TASK OF NORMAL AND MENTALLY HANDICAPPED CONTROL AND EXPERIMENTAL GROUPS

N = 40

GROUP	CONTROL		EXPERIMENTAL		DIFFERENCE	t	PROBABILITY
	M	σ	M	σ			
Normal	4.83	5.30	2.00	3.71	2.83	2.727	<.01
Range	(-6-18)		(-4-14)				
Mentally Handicapped	2.85	5.23	3.08	4.06	-1.23	1.156	>.05
Range	(-4-18)		(-7-13)				

Task as compared to an increase of 2.85 with a range from -4 to 18 for the control group on Presentation II of the Original Task. The mentally handicapped experimental group showed greater change from the initial to eighth trial of the Interpolated Task than did the mentally handicapped control group on Presentation II of the Original Task. The difference was 1.23, which was not statistically significant.

Figure 5 shows graphically the learning curves of the normal control group on Presentations I and II of the Original Task and the normal experimental group on Presentation I of the Original Task and the Interpolated Task. It will be noted that a fairly smooth curve of learning is shown for the total number of trials for the control group for Presentation II of the Original Task, continuing from Presentation I. The curve of Presentation I of the Original Task for the normal experimental group closely parallels the curve of the normal control group for Presentation I of the Original Task. When the normal experimental group was administered the Interpolated Task, however, it will be noted that while they started at a slightly higher number of correct items on the initial presentation than they had on Presentation I of the Original Task, much less growth occurred. The number of correct items on the final trial is considerably lower than the number of correct items of the same numbered trial for either the normal control or experimental group on Presentation I of the Original Task or any of the trials of the normal control group on Presentation II of the Original Task.

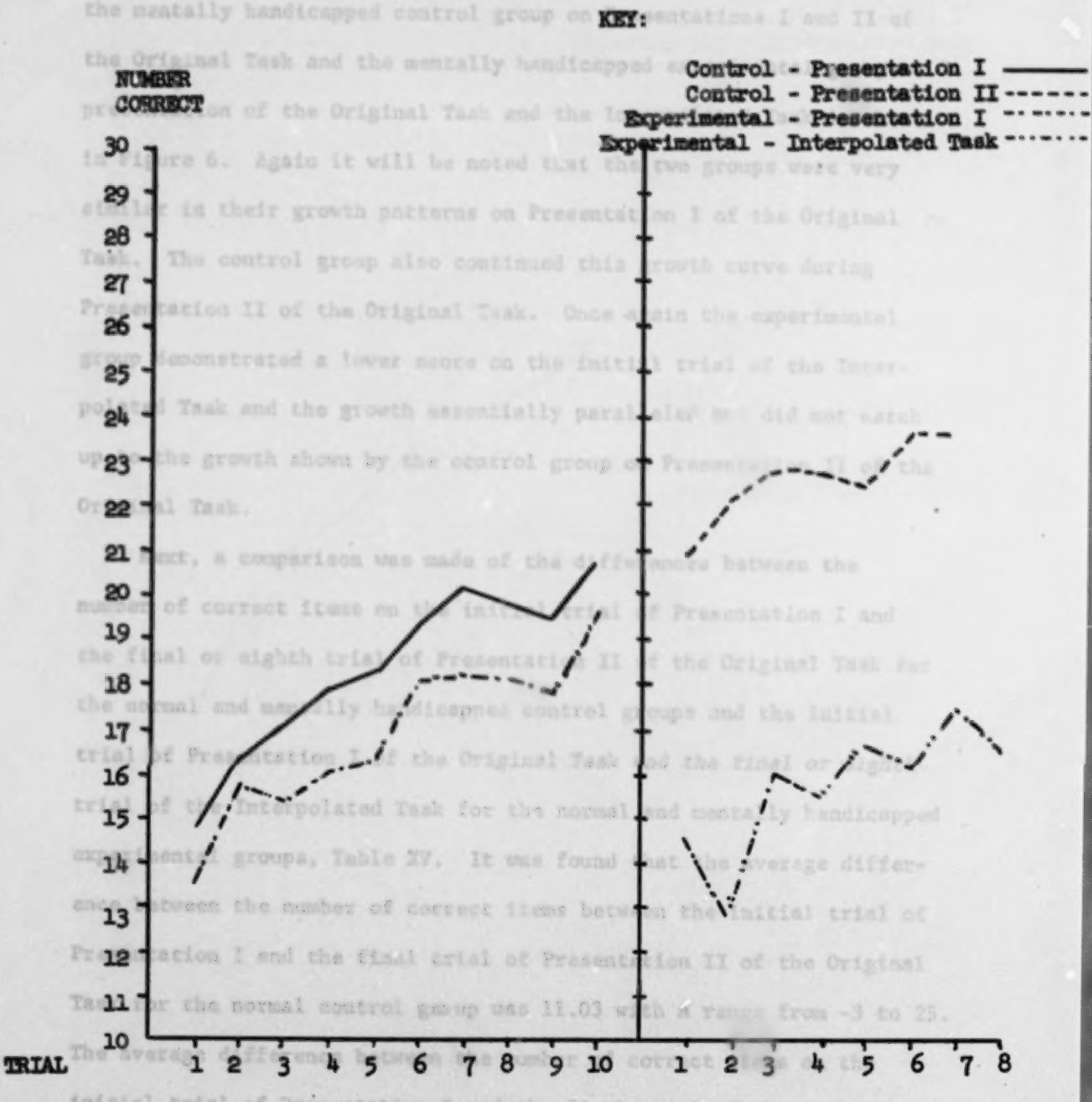

Figure 5

NORMAL CONTROL AND EXPERIMENTAL GROUPS - LEARNING CURVES ON PRESENTATION I AND II OF ORIGINAL TASK AND INTERPOLATED TASK.

A similar presentation of the data for the learning curves of the mentally handicapped control group on Presentations I and II of the Original Task and the mentally handicapped experimental group on presentation of the Original Task and the Interpolated Task is shown in Figure 6. Again it will be noted that the two groups were very similar in their growth patterns on Presentation I of the Original Task. The control group also continued this growth curve during Presentation II of the Original Task. Once again the experimental group demonstrated a lower score on the initial trial of the Interpolated Task and the growth essentially paralleled but did not catch up to the growth shown by the control group on Presentation II of the Original Task.

Next, a comparison was made of the differences between the number of correct items on the initial trial of Presentation I and the final or eighth trial of Presentation II of the Original Task for the normal and mentally handicapped control groups and the initial trial of Presentation I of the Original Task and the final or eighth trial of the Interpolated Task for the normal and mentally handicapped experimental groups, Table XV. It was found that the average difference between the number of correct items between the initial trial of Presentation I and the final trial of Presentation II of the Original Task for the normal control group was 11.03 with a range from -3 to 25. The average difference between the number of correct items on the initial trial of Presentation I and the final trial of the Interpolated Task for the normal experimental group was 2.95. The difference, 8.08, was significant at less than the .001 level of confidence. The difference between the means of the mentally handicapped control and

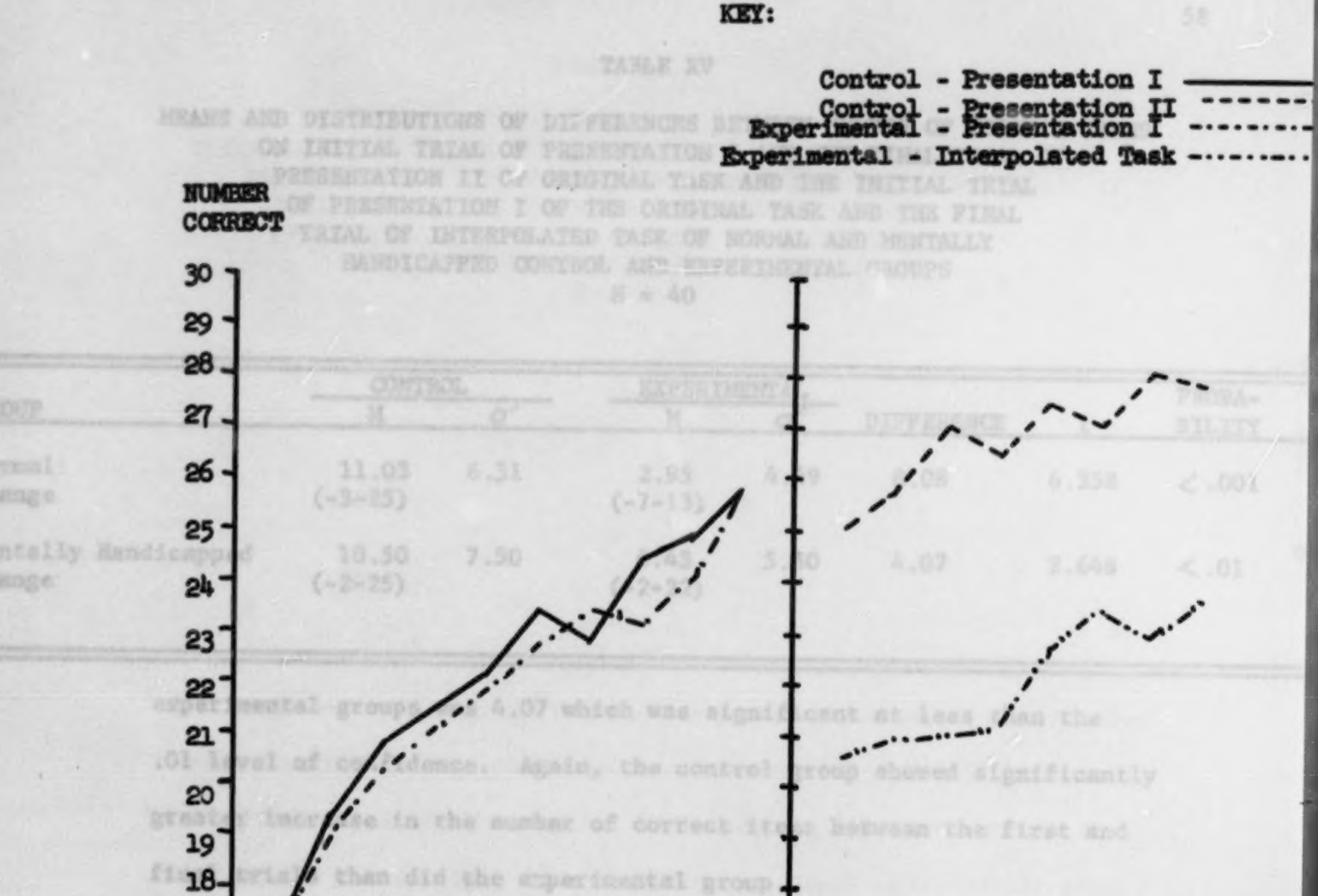

Figure 6

MENTALLY HANDICAPPED CONTROL AND EXPERIMENTAL GROUPS - LEARNING CURVES ON PRESENTATION I AND II OF ORIGINAL TASK AND INTERPOLATED TASK.

TABLE XV

MEANS AND DISTRIBUTIONS OF DIFFERENCES BETWEEN NUMBER OF CORRECT ITEMS ON INITIAL TRIAL OF PRESENTATION I AND THE FINAL TRIAL OF PRESENTATION II OF ORIGINAL TASK AND THE INITIAL TRIAL OF PRESENTATION I OF THE ORIGINAL TASK AND THE FINAL TRIAL OF INTERPOLATED TASK OF NORMAL AND MENTALLY HANDICAPPED CONTROL AND EXPERIMENTAL GROUPS

N = 40

	CONTROL		EXPERIMENTAL				
GROUP	M	σ	M	σ	DIFFERENCE	t	PROBABILITY
Normal	11.03	6.51	2.95	4.49	8.08	6.358	< .001
Range	(-3-25)		(-7-13)				
Mentally Handicapped	10.50	7.50	6.43	5.50	4.07	2.646	< .01
Range	(-2-25)		(-2-22)				

experimental groups was 4.07 which was significant at less than the .01 level of confidence. Again, the control group showed significantly greater increase in the number of correct items between the first and final trials than did the experimental group.

Finally, a comparison was made of the differences between the number of correct items on the initial trial of Presentation I and the final trial of Presentation II of the Original Task of the normal and mentally handicapped control groups and the first trial of Presentation I of the Original Task and the final trial of the Interpolated Task of the normal and mentally handicapped experimental groups (Table XVI). The difference of 0.53 that was found between the mean increase in number of correct items for the normal and mentally handicapped control groups was not statistically significant. A difference of 3.48 was found between the normal and mentally handicapped experimental groups. This difference was significant at less than the

TABLE XVI

MEANS AND DISTRIBUTIONS OF DIFFERENCES BETWEEN NUMBER OF CORRECT ITEMS ON INITIAL TRIAL OF PRESENTATION I AND FINAL TRIAL OF PRESENTATION II OF ORIGINAL TASK AND FIRST TRIAL OF PRESENTATION I OF ORIGINAL TASK AND FINAL TRIAL OF INTERPOLATED TASK OF CONTROL AND EXPERIMENTAL NORMAL AND MENTALLY HANDICAPPED GROUPS

N = 40

	CONTROL		EXPERIMENTAL				
GROUP	M	σ	M	σ	DIFFERENCE	t	PROBABILITY
Control	11.03	6.51	10.50	7.50	0.53	0.320	$>.05$
Range	(-3-25)		(-2-25)				
Experimental	2.95	4.49	6.43	5.50	3.48	3.048	$<.001$
Range	(-7-13)		(-2-22)				

.001 level of confidence. The mentally handicapped experimental group showed significantly greater increase in number of correct items from the initial trial of Presentation I of the Original Task and the final trial of the Interpolated Task than did the normal experimental group. The mean of the mentally handicapped experimental group was 6.43 with a range from -2 to 22, while the mean for the normal experimental group was 2.95, with a range from -7 to 13.

Retroactive Inhibition

A trend analysis was employed in the evaluation of the performance scores obtained on Presentation II of the Original Task by the normal control and experimental groups and by the mentally handicapped control and experimental groups, Tables XVII and XVIII. It will be noted that there was no evidence of a difference between the displacement of the curves of the mentally handicapped control and mentally handicapped

TABLE XVII

TREND ANALYSIS OF PERFORMANCE ON PRESENTATION II OF ORIGINAL TASK NORMAL CONTROL - NORMAL EXPERIMENTAL

SOURCE	df	SUM OF SQUARES	MEAN SQUARE	F	P
Total	abs-1 8x2x40-1=639	25,642.90			
Between Subjects	bs-1 2x40-1=79	20,354.44			
Between Groups	b-1 2-1=1	4,687.22	4,687.22	18.71	.001
Error (b)	bs-b 2x40-2=78	19,537.25	250.48		
Within Subjects	bs(a-1) 2x40(8-1)=560	5,288.46			
A (Trials)	a-1 8-1=7	817.19	116.74	14.59	.001
AB (Trials x Groups)	(a-1)(b-1) (8-1)(2-1)=7	102.98	14.71	1.84	
Error (w)	(a-1)(bs-b) (8-1)(2x40-2)=546	4,368.29	8.00		

TABLE XVIII

TREND ANALYSIS OF PERFORMANCE ON PRESENTATION II OF ORIGINAL TASK MENTALLY HANDICAPPED CONTROL - MENTALLY HANDICAPPED EXPERIMENTAL

SOURCE		SUM OF SQUARES	MEAN SQUARE	F	P
Total	abs-1 8x2x40-1=639	44,828.78			
Between Subjects	bs-1 2x40-1=79	38,482.86			
Between Groups	b-1=1 2-1=1	577.59	577.59	1.19	
Error (b)	bs-b 80-2=78	37,905.27	485.96		
Within Subjects	bs(a-1) 2x40x8-1=560	6,345.92			
A (Trials)	a-1 8-1=7	1,032.31	147.47	15.44	.001
AB (Trials x Groups)	(a-1)(b-1) (8-1(2-1)=7	96.98	13.85	1.45	
Error (w)	(a-1)(bs-b) 7x78=546	5,216.63	9.55		

experimental groups and that the slopes of the curves were not parallel. It could be inferred that a significant amount of learning took place inasmuch as the hypothesis that the slope of the curves equalled zero was rejected at the .001 level of confidence. Inasmuch as there was no difference between the displacement of the curves and inasmuch as the curves were parallel, the interpolated task apparently had no significant effect upon the learning that took place during Presentation II of the Original Task for the mentally handicapped experimental group. The Interpolated Task, however, affected the performance of the normal experimental group during Presentation II of the Original Task. It was found that there was a significant difference (at the .001 level) between the displacement of the curves between the normal control and normal experimental groups although the slopes of the curves were essentially parallel. In addition, there was evidence that learning took place inasmuch as there was a significant difference between successive trial means. The hypothesis that the slope of the lines connecting the separate trial means equalled zero was rejected at the .001 level of confidence.

Since it was thought that the groups may have reached their maximum performance level during the total of the 18 trials during Presentations I and II of the Original Task, a trend analysis was also made of the scores of the mentally handicapped control and normal control groups (Tables XIX and XX). This was not found to be true since the hypothesis that the slope of the curves equalled zero was rejected at the .01 level of confidence, indicating that learning was still taking

TABLE XIX

TREND ANALYSIS OF PERFORMANCE ON PRESENTATION II OF ORIGINAL TASK MENTALLY HANDICAPPED CONTROL - NORMAL CONTROL

SOURCE	df	SUM OF SQUARES	MEAN SQUARE	F	P
Total	abs-1 8x2x40-1=639	36,592.50			
Between Subjects	bs-1 2x40-1=79	31,058.32			
Between Groups	b-1 2-1=1	2,480.62	2,480.62	6.77	.025
Error (b)	bs-b 80-2=78	28,577.70	366.38		
Within Subjects	bs(a-1) 2x40(8-1)=560	5,534.18			
A (Trials)	a-1 8-1=7	751.89	107.41	7.88	.001
AB (Groups x Trials)	(a-1)(b-1) (8-1)(2-1)=7	95.38	13.63	1.56	
Error (w)	(a-1)(bs-b) (8-1)(80-2)=546	4,782.29	8.76		

TABLE XX

TREND ANALYSIS OF PERFORMANCE ON PRESENTATION I OF ORIGINAL TASK MENTALLY HANDICAPPED CONTROL - NORMAL CONTROL

SOURCE	df	SUM OF SQUARES	MEAN SQUARES	F	P
Total	abs-1 10x2x40-1=799	32,950.54			
Between Subjects	bs-1 2x40-1=79	23,313.64			
Between Groups	b-1 2-1=1	2,907.03	2,907.03	11.11	.005
Error (b)	bs-b 80-2=78	20,406.61	261.62		
Within Subjects	bs(a-1) 2(40)(10-1)=750	9,636.90			
A (Trials)	a-1 10-1=9	3,736.09	415.12	49.36	.001
AB (Trials x Groups)	(a-1)(b-1) 9x1=9	150.20	16.69	1.98	
Error (w)	(a-1)(bs-b) 9x78=702	5,900.81	8.41		

place. The displacement of the curves of the two groups was also significantly different at the .05 level of confidence although the slopes of the curves were essentially parallel.

It will be noted from Tables XX and XXI that the normal and mentally handicapped control and experimental groups differed in the displacement of the learning curves significantly at the .01 level of confidence on Presentation I of the Original Task. Learning took place since the hypothesis that the slope of the curves equalled zero was rejected at the .001 level of confidence. The slopes of the curves, however, were essentially parallel. The displacement of the learning curves for the normal and mentally handicapped experimental groups also differed significantly - the .001 level of confidence. Learning also took place for the experimental groups since the hypothesis that the slope of the curves equalled zero was rejected at the .001 level of confidence. When comparing the parallelness of the slopes of the learning curves, it was found that the slopes for the normal and mentally handicapped experimental groups were not parallel. The hypothesis of parallelness of slopes was rejected at the .001 level of confidence. This was the only test of parallelness on either Presentation I or Presentation II for both controls and experimentals that the hypothesis of parallelness was rejected, Tables XVII, XVIII, XIX, XX, and XXI.

Since the mentally handicapped experimental group started with an initially higher score than the normal experimental group, an analysis of co-variance was used so that the difference in initial ability could be controlled by statistical means. (It will be remembered that

TABLE XXI

TREND ANALYSIS OF PERFORMANCE ON PRESENTATION I OF ORIGINAL TASK MENTALLY HANDICAPPED EXPERIMENTAL - NORMAL EXPERIMENTAL

SOURCE	df	SUM OF SQUARES	MEAN SQUARE	F	P
Total	abs-1 10x2x40-1=799	36,918.22			
Between Subjects	bs-1 2x40-1=79	30,827.82			
Between Groups	b-1 2-1=1	5,070.24	5,070.24	15.35	.001
Error (b)	bs-b 80-2=78	25,757.58	330.23		
Within Subjects	bs(a-1) 2x40x10-1=720	6,090.40			
A (Trials)	a-1 10-1=9	3,161.41	351.27	89.84	.001
AB (Trials x Groups)	(a-1)(b-1) 9x1=9	185.17	20.57	5.26	.001
Error (w)	(a-1)(b-1) 9x78=702	2,743.82	3.91		

mental age was controlled mechanically in the original matching of the groups.) In this way it could be determined whether or not there was a significant difference between the two groups in regard to the effect of the Interpolated Task when the effect of differences in initial ability was held constant. It was found, using an analysis of co-variance, that the mentally handicapped experimental group scored significantly higher than the normal experimental group on the second presentation of the Original Task. The difference was significant at the .005 level of confidence.

Figure 7 displays graphically the learning curves of the normal control and normal experimental groups on Presentations I and II of the Original Task. It is very obvious from an examination of this figure that the inserting of the Interpolated Task between the two presentations of the Original Task for the normal experimental group definitely affected their performance on the second presentation of the Original Task. This was verified in the trend analysis summarized in Tables XVII and XVIII for the difference in the displacement of the two curves for the normal control and experimental groups for Presentation II of the Original Task was significant at the .001 level of confidence.

Figure 8 is a similar graphical presentation of the learning curves of the mentally handicapped control and mentally handicapped experimental groups on Presentations I and II of the Original Task. In this figure, while it appears that the performance of the experimental group on Presentation II was somewhat affected by the intervening Interpolated Task, the effect was not nearly as great as

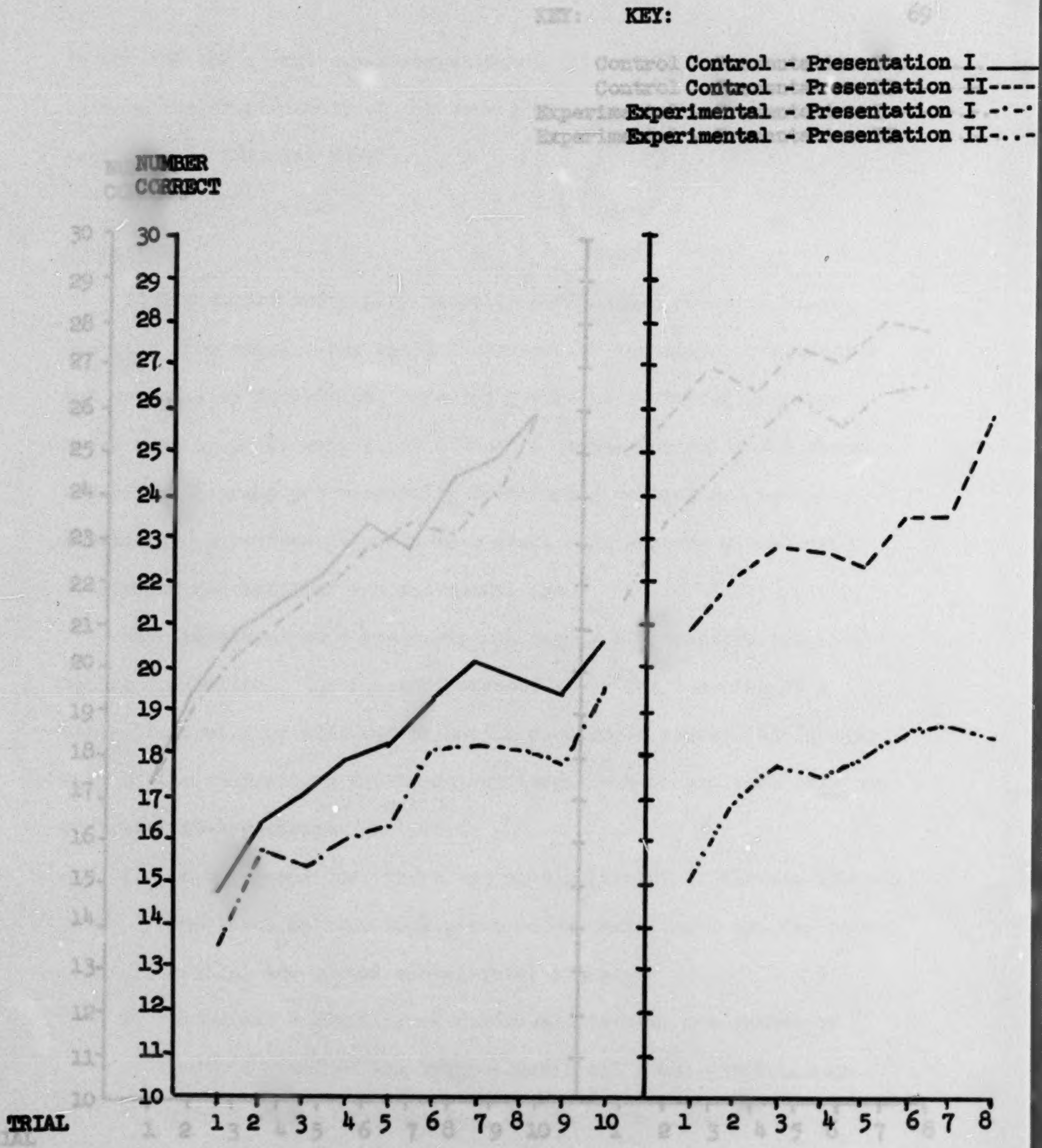

Figure 7

NORMAL CONTROL AND EXPERIMENTAL GROUPS - LEARNING CURVES ON PRESENTATION I AND II OF ORIGINAL TASK.

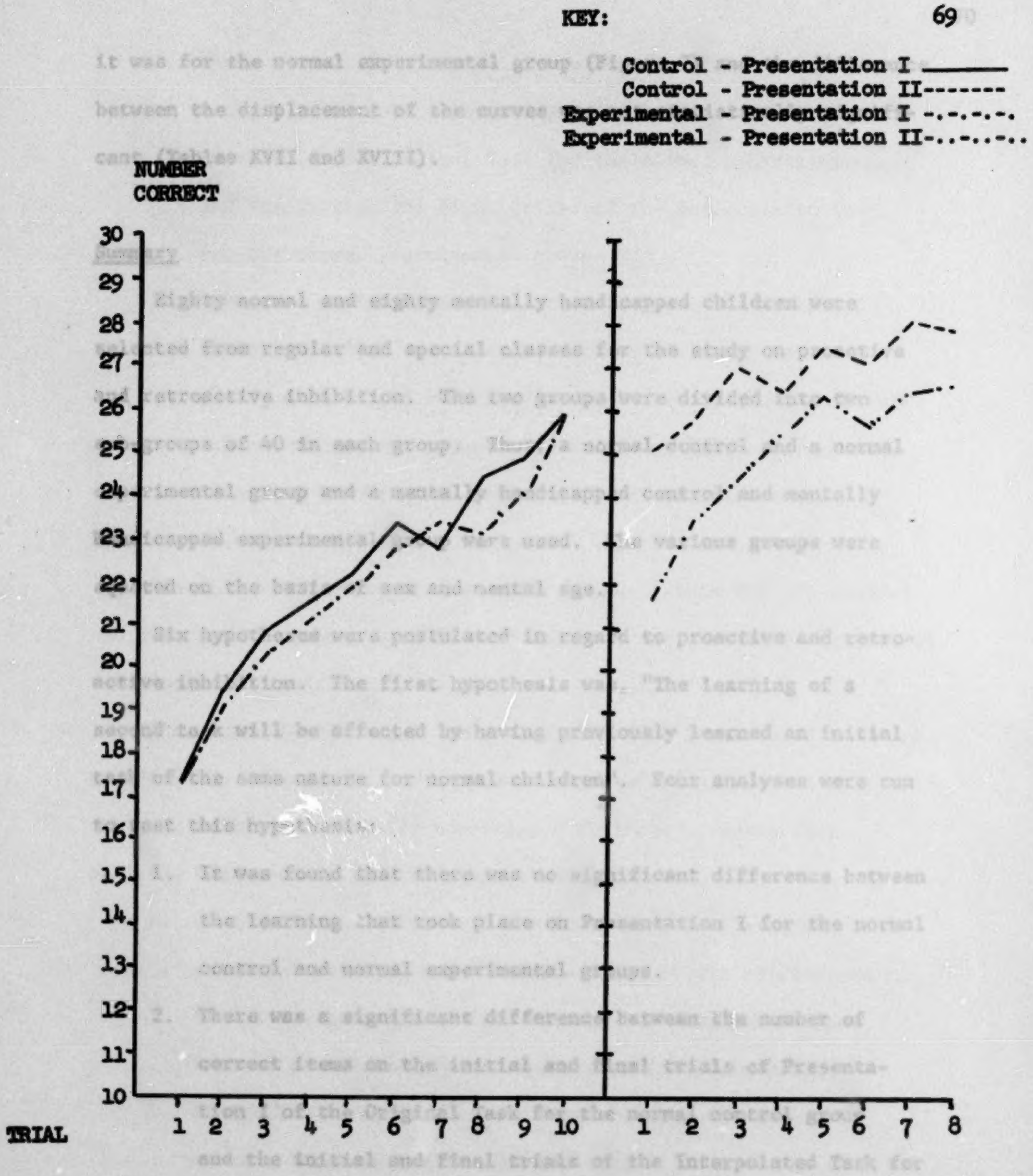

Figure 8

MENTALLY HANDICAPPED CONTROL AND EXPERIMENTAL GROUPS - LEARNING CURVES ON PRESENTATIONS I AND II OF ORIGINAL TASK.

it was for the normal experimental group (Figure 7) and the difference between the displacement of the curves was not statistically significant (Tables XVII and XVIII).

Summary

Eighty normal and eighty mentally handicapped children were selected from regular and special classes for the study on proactive and retroactive inhibition. The two groups were divided into two sub-groups of 40 in each group. Thus, a normal control and a normal experimental group and a mentally handicapped control and mentally handicapped experimental group were used. The various groups were equated on the basis of sex and mental age.

Six hypotheses were postulated in regard to proactive and retroactive inhibition. The first hypothesis was, "The learning of a second task will be affected by having previously learned an initial task of the same nature for normal children". Four analyses were run to test this hypothesis:

1. It was found that there was no significant difference between the learning that took place on Presentation I for the normal control and normal experimental groups.
2. There was a significant difference between the number of correct items on the initial and final trials of Presentation I of the Original Task for the normal control group and the initial and final trials of the Interpolated Task for the normal experimental group.

3. There was a significant difference between the number of correct items on the initial and final trials of Presentation II of the Original Task for the normal control group and the initial and final trials of the Interpolated Task for the normal experimental group.
4. There was a significant difference between the number of correct items on the initial trial of Presentation I and the final trial of Presentation II of the Original Task for the normal control group and the initial trial of Presentation I of the Original Task and the final trial of the Interpolated Task for the normal experimental group.

Since the differences between the various trials for the control and experimental groups were in each instance statistically significant, the hypothesis could not be rejected.

The second hypothesis to be tested was, "The learning of a second task will be affected by having previously learned an initial task of the same nature for mentally handicapped children". Again four analyses were made to test this hypothesis:

1. No significant difference was found between the number of correct items on the initial and final trials of Presentation I of the Original Task for the mentally handicapped control and mentally handicapped experimental groups.
2. A significant difference was found between the number of correct items on the initial and final trials of Presentation I of the Original Task for the mentally handicapped control group and the initial and final trials of the Interpolated

Task of the mentally handicapped experimental group.

3. The difference between the number of correct items on the initial and final trials of Presentation II of the Original Task for the mentally handicapped control group and the initial and final trials of the Interpolated Task for the mentally handicapped experimental group was not significant.
4. A significant difference was found between the number of correct items on the initial trial of Presentation I and the final trial of Presentation II of the Original Task for the mentally handicapped control group and the initial trial of Presentation I of the Original Task and the final trial of the Interpolated Task for the mentally handicapped experimental group.

Two of the three tests between the various trials for the control and experimental groups indicated that there was a statistically significant difference between the mean scores. Thus, the hypothesis could not be rejected.

The third hypothesis to be tested was, "There will be no differences concerning the affect of previous learnings on subsequent learnings between normal and mentally handicapped groups of children of the same mental age". In comparing the differences between the number of correct items on the initial trial of Presentation I and the final trial of Presentation II of the Original Task for the normal and mentally handicapped control groups, it was found that there was no significant difference between the scores of the two groups. When a similar comparison was made concerning the number of correct items between the first trial of Presentation I of the Original Task and the final trial of the Interpolated Task for the experimental normal and mentally handicapped groups, it was found that there was a difference of 3.48 items, which was significant at the .001 level of confidence. A statistically significant difference was shown between the mentally handicapped and normal experimental groups (the mentally handicapped being less affected). Thus, the hypothesis was rejected.

The fourth hypothesis to be tested was, "When the learning of a task is interrupted with the learning of a task of a similar nature, the completion of the learning of the original task will be affected in normal children". A trend analysis was run and it was found that there was a significant difference in the displacement of the learning curves of the normal control and normal experimental groups, thus indicating that the Interpolated Task had affected the further learning of the Original Task for the normal experimental group. The hypothesis could not be rejected.

The fifth hypothesis to be tested was, "When the learning of a task is interrupted with the learning of a task of a similar nature, the completion of the learning of the original task will be affected in mentally handicapped children". A similar analysis was made as had been run for the normal groups. It was found that there was no significant difference concerning the displacement of the learning curves between the mentally handicapped control and mentally handicapped experimental groups. Thus, the hypothesis was rejected.

The sixth hypothesis to be tested was, "There will be no differences concerning the characteristics of affect of having the learning of a task interrupted with the learning of a task of a similar nature between normal and mentally handicapped groups of children of the same mental age". Since the groups had been equated on the basis of mental age but differed on their performance of the initial task, an analysis of co-variance was used to control for the difference in initial ability. It was found that the mentally handicapped experimental and normal experimental groups differed in their learning scores on the final task at the .005 level of confidence. Since the difference between the two groups was significant, the hypothesis was rejected.

Of the six hypotheses tested concerning retroactive and proactive inhibition, it was found that the learning of normal children was affected by a previously learned task of the same nature and having the learning of a task interrupted by the learning of a task of a similar nature. The learning of mentally handicapped children was affected by a previously learned task of the same nature but not by having the learning of a task interrupted by the learning of a task of a similar nature. The mentally handicapped children were affected to a significantly smaller degree than the normal children by both preactive and retroactive inhibition.

CHAPTER V

GENERALIZATION (TRANSFER OF A PRINCIPLE)

PROCEDURE

Thirty-six normal children and thirty-six mentally handicapped children were selected from regular grades and special classes within the public schools. Both the normal and mentally handicapped groups of children were divided into two subgroups (control and experimental) of 18 subjects each. Tables XXII and XXIII provide a summary of the characteristics (chronological age, mental age, and intelligence quotient) of the groups.

The chronological ages of the children included in the total normal group ranged from 97 to 131 months with a mean of 111.17 months. The chronological ages of the children included in the total mentally handicapped group ranged from 121 to 183 months with a mean of 150.97 months. The mentally handicapped children, on an average, were 39.80 months older than the normal children. A similar difference was apparent in the intelligence quotients of the two groups where the mean I.Q. of the normal group was 35,49 points higher than the mean I.Q. of the mentally handicapped group. The mean intelligence quotient of the total group of normal children was 104.94 with a range from 91 to 124 and the mean intelligence quotient of the total mentally handicapped group of children was 69.45 with a range from 60 to 79. Since the children with normal intelligence were younger than the mentally handicapped children, there was less disparity between the mental ages of the

TABLE XXII

MEANS AND DISTRIBUTIONS OF CHRONOLOGICAL AGES, MENTAL AGES, AND INTELLIGENCE QUOTIENTS OF TOTAL, NORMAL AND MENTALLY HANDICAPPED GROUPS, CONTROL NORMAL AND MENTALLY HANDICAPPED GROUPS, AND EXPERIMENTAL NORMAL AND MENTALLY HANDICAPPED GROUPS USED IN GENERALIZATION STUDY

TOTAL - N = 36	NORMAL		MENTALLY HANDICAPPED				PROBA-BILITY
	M	σ	M	σ	DIFFERENCE	t	
C.A.	111.17 mo.	8.72	150.97 mo.	18.38	39.80 mo.	8.073	< .001
Range	(97-131)		(121-183)				
M.A.	116.72 mo.	13.67	102.99 mo.	9.96	13.73 mo.	3.349	< .001
Range	(90-144)		(80-130)				
I.Q.	104.94	8.83	69.45	4.59	35.49	21.125	< .001
Range	(91-124)		(60-79)				
CONTROL - N = 18	NORMAL		MENTALLY HANDICAPPED				PROBA-BILITY
	M	σ	M	σ	DIFFERENCE	t	
C.A.	110.89 mo.	7.87	142.55 mo.	18.50	31.66 mo.	6.488	< .001
Range	(97-126)		(121-181)				
M.A.	115.22 mo.	13.92	98.06 mo.	9.03	17.16 mo.	4.271	< .001
Range	(91-144)		(80-114)				
I.Q.	103.77	8.54	69.72	4.89	34.05	14.307	< .001
Range	(92-124)		(60-79)				
EXPERIMENTAL - M = 18	NORMAL		MENTALLY HANDICAPPED				PROBA-BILITY
	M	σ	M	σ	DIFFERENCE	t	
C.A.	111.44 mo.	9.48	159.39 mo.	13.85	47.95 mo.	11.781	< .001
Range	(99-131)		(139-183)				
M.A.	118.22 mo.	13.24	107.94 mo.	8.25	10.28 mo.	2.712	< .01
Range	(90-137)		(96-130)				
I.Q.	106.11	8.96	69.17	4.26	36.94	15.328	< .001
Range	(91-124)		(60-75)				

two total groups. The mean mental age of the total normal group was 116.72 months (with a range from 90 to 144) and the mean mental age of the total mentally handicapped group was 102.99 months (with a range from 80 to 130). The difference between the mean mental ages was 13.73 months. Table XXII also contains similar comparative data regarding chronological ages, mental ages, and intelligence quotients for the control normal and mentally handicapped groups and the experimental normal and mentally handicapped groups.

From an examination of Table XXIII it will be noted that the normal control and normal experimental groups are very similar in regard to chronological age, mental age, and intelligence quotient. In no instance is the relatively small difference between the means statistically significant. The differences between the mentally handicapped control and experimental groups were somewhat greater. The only factor on which the means do not differ significantly is the intelligence quotients. The mentally handicapped experimental group was significantly older and had a significantly higher mental age than the mentally handicapped control group, the differences between the means being 16.84 months and 9.88 months, respectively.

The objective of the study was to compare abilities to generalize of normal and mentally handicapped children of the same mental age. Since the measured mean mental ages of the groups differed significantly, it was necessary to control for this factor statistically. As a result, an analysis of co-variance was used.

The subjects were tested in a group situation with a maximum of

TABLE XXIII

MEANS AND DISTRIBUTIONS OF CHRONOLOGICAL AGES, MENTAL AGES, AND INTELLIGENCE QUOTIENTS OF NORMAL CONTROL AND EXPERIMENTAL GROUPS AND MENTALLY HANDICAPPED CONTROL AND EXPERIMENTAL GROUPS USED IN GENERALIZATION STUDY

NORMAL - N = 18	CONTROL		EXPERIMENTAL				
	M	σ	M	σ	DIFFERENCE	t	PROBABILITY
C.A. Range	110.89 mo. (97-126)	7.87	111.44 mo. (99-131)	9.48	0.55 mo.	0.151	>.05
M.A. Range	115.22 mo. (91-144)	13.92	118.22 mo. (90-137)	13.24	3.00 mo.	0.644	>.05
I.Q. Range	103.77 (92-124)	8.54	106.11 (91-124)	8.96	2.34	0.780	>.05

MENTALLY HANDICAPPED - N = 18	CONTROL		EXPERIMENTAL				
	M	σ	M	σ	DIFFERENCE	t	PROBABILITY
C.A. Range	142.55 mo. (121-181)	18.50	159.39 mo. (139-183)	13.85	16.84 mo.	3.007	< .001
M.A. Range	98.06 mo. (80-114)	9.03	107.94 mo. (96-130)	8.25	9.88 mo.	3.330	< .001
I.Q. Range	69.72 (60-79)	4.89	69.17 (60-75)	4.26	0.55	0.350	>.05

ten subjects at a time. Each subject was assigned a seat and given a number that was placed on his table from 1 through 10 for easy identification and to aid the examiners in obtaining accurate time measurements. Two examiners were used to insure understanding of directions and accuracy of timing.

On Friday, the first day, all the control and experimental subjects were given a test item containing five parts (Appendix F, Assembly Test 1). First, they were directed to take the test item apart and lay the parts on the tray that was provided. Second, they were shown how to reassemble the test item and told to reassemble the one they had just taken apart. Third, they were directed to disassemble and reassemble the test item. Those who could not were given additional help and instruction until they understood the task. Fourth, 10 of the identical test items were distributed to each child and they were directed to disassemble them. Finally, when all the test items were disassembled they were told to assemble them (10) as rapidly as possible and time was kept for each child. The time required to assemble the 10 test items was recorded as the Initial Performance on Assembly Test I.

The two control groups (normal and mentally handicapped) practiced disassembling and reassembling ten of the same test items (Appendix F, Assembly Test 1) on Monday, Tuesday, Wednesday, and Thursday of the following week. No additional instruction was given and each trial was timed.

The procedure for the experimental groups was somewhat different. On Monday each child was again given 10 of the items upon which they had been tested on the previous Friday, (Appendix F, Assembly Test 1), and shown how to organize the parts, as they disassembled the test items, into specific piles so that they would be able to assemble them more efficiently. After disassembling the 10 test items they were then given a time trial in reassembling them. On Tuesday they were given a new assembly task (Appendix F, Assembly Practive Item 1), with instructions on how to disassemble, reassemble, and organize the materials. They were timed for the reassembly. The same procedure was followed Wednesday and Thursday, again with unique items each day (Appendix F, Assembly Practice Items 2 and 3).

All groups, control and experimental, were again given the original test item (Appendix F, Assembly Test 1) on Friday, with no additional instruction, and timed once again.

Following the completion of the original test, a unique assembly test item (Appendix F, Assembly Test 2) was given to each child in both the normal and mentally handicapped control and experimental groups. Directions were given as to how to assemble the item, but no directions were provided the experimental groups regarding the organization of the materials for rapid, efficient reassembly. All the children were merely directed to disassemble the 10 items after the initial assembly instruction. After the objects had been disassembled, the children were told to reassemble them as rapidly as possible and were timed in the reassembly. The time required for reassembly was tabulated as the Transfer Test Score.

One-hundred test items of each kind were selected or manufactured for the purposes of the study. In this way each of 10 children would have 10 items upon which he would be tested at the same time. At the end of the 6 testing sessions, the following scores were available: Initial performance on Assembly Test 1, each of the practice tests, final performance on Assembly Test 1, and Transfer Test for the children in the control groups, and initial performance on Assembly Test 1, each of the training tests, final performance on Assembly Test 1, and Transfer Test for the children in the experimental groups.

RESULTS

Comparisons were made of the performance of the 4 groups (normal control, normal experimental, mentally handicapped control, and mentally handicapped experimental) to determine (1) the effect of instruction on the mentally handicapped and normal experimental groups as compared to the mentally handicapped and normal control groups, and (2) whether there was any difference in the effect of instruction between the normal experimental and mentally handicapped experimental groups.

Before any analysis of the results of the learning tasks could be made, it was necessary to pair the mental ages of the various groups involved (Table XXIV), since the hypothesis originally postulated was based upon groups that were equated on the basis of mental age. A *t* test was run to determine whether or not the differences between the mental ages of the normal control and experimental groups, mentally handicapped control and experimental groups, normal and mentally handicapped control groups, and normal and mentally handicapped experimental groups were significant. In each instance, except for the difference in mental ages between the normal control and normal experimental groups, it was found that the difference in mental age would occur less than 1 time in 100 by chance. It was, therefore, necessary to use an analysis of co-variance to control for the initial differences in mental age when evaluating the significance of the relationships of the practice and transfer data obtained on the test items.

A second initial pre-testing of the groups was made to determine how the groups compared on their initial performance on Assembly

TABLE XXIV

SIGNIFICANCE OF DIFFERENCES BETWEEN MEAN MENTAL AGES OF NORMAL CONTROL AND EXPERIMENTAL GROUPS, MENTALLY HANDICAPPED CONTROL AND EXPERIMENTAL GROUPS, NORMAL AND MENTALLY HANDICAPPED CONTROL GROUPS, AND NORMAL AND MENTALLY HANDICAPPED EXPERIMENTAL GROUPS

	MENTAL AGE (months)					
	MEAN (months)	DIFFERENCE	t	PROBABILITY	F	PROBABILITY
Normal Control	115.22					
Normal Experimental	118.22	3.00	0.64	>.05	1.10	>.05
Mentally Handicapped Control	98.06					
Mentally Handicapped Experimental	107.94	9.88	3.33	<.01	1.20	>.05
Normal Control	115.22					
Mentally Handicapped Control	98.06	17.16	4.27	<.01	2.37	>.05
Normal Experimental	118.22					
Mentally Handicapped Experimental	107.94	10.28	2.71	<.01	2.59	<.05

Test 1, Table XXV. It was found that the normal control and normal experimental groups and the mentally handicapped control and mentally handicapped experimental groups compared very closely on their average initial performance, the mean time required to assemble the 10 objects being less than 2 seconds apart for each comparison. These differences were not significant in that the probability of their occurring by chance was greater than five times in 100. When the normal and mentally handicapped control groups were compared on the basis of their initial performance on Assembly Test 1 (Table XXIV), it was found that the mean times of the two groups differed 48.16 seconds. The mean time difference between the normal and mentally handicapped experimental groups on the initial performance was almost as great, being 46.44 seconds. These differences, however, were not statistically significant, either.

Thus, the four groups examined were not found to differ significantly in terms of their initial performance but they did differ in mean mental age. As a result, the statistical analyses consisted of two steps. First, an analysis of co-variance was performed. Second, when the F-ratio thus obtained was found to be significant, subsequent steps were taken in order to compute the individual treatment means and the differences between the pairs of individual treatment means.*

The first analysis concerning the scores on the final performance on Assembly Test 1 and the Transfer Test Scores was made in order to

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*E. F. Lindquist, Design and Analusis of Experiments in Psychology and Education, Boston: Houghton-Mifflin Co., 1953, pp. 317-39.

TABLE XXV

COMPARISON OF MEAN MENTAL AGES AND MEAN SCORES ON INITIAL PERFORMANCE ON ASSEMBLY TEST 1 OF NORMAL CONTROL AND EXPERIMENTAL GROUPS, MENTALLY HANDICAPPED CONTROL AND EXPERIMENTAL GROUPS, NORMAL AND MENTALLY HANDICAPPED CONTROL GROUPS, AND NORMAL AND MENTALLY HANDICAPPED EXPERIMENTAL GROUPS

	MENTAL AGE (months)				INITIAL PERFORMANCE (seconds)			
	MEAN	DIFF.	t	PROBABILITY	MEAN	DIFF.	t	PROBABILITY
Normal Control	115.22				303.22			
Normal Experimental	118.22	3.00	0.64	>.05	302.33	0.89	0.02	>.05
Mentally Handicapped Control	98.06				254.06			
Mentally Handicapped Experimental	107.94	9.88	3.33	<.01	255.89	1.83	0.02	>.05
Normal Control	115.22				303.22			
Mentally Handicapped Control	98.06	17.16	4.27	<.01	254.06	48.16	1.50	>.05
Normal Experimental	118.22				302.33			
Mentally Handicapped Experimental	107.94	10.28	2.71	<.01	255.89	46.44	1.19	>.05

determine whether or not transfer had occurred for the normal and mentally handicapped groups. The results of the analyses of co-variance are contained in Table XXVI. The F-ratio of 9.22 resulting from an analysis of the difference between the final performance scores on Assembly Test 1 of the normal control and the normal experimental groups is associated with a probability of less than .01. The corresponding F-ratio associated with the performance of these two groups on the Transfer Test is 5.72. The probability of this value is less than .05, Table XXVII. In comparing the adjusted means of the normal control and normal experimental groups, it was found that the normal control accomplished Assembly Test 1 on the final performance 11.89 seconds more rapidly than did the normal experimental group. This difference was significant at the 1 percent level of confidence. When a unique (Transfer) task, which neither the control nor the experimental group had previously seen, was given to them to assemble, it was

TABLE XXVI

ANALYSIS OF CO-VARIANCE: FINAL PERFORMANCE SCORES ON ASSEMBLY TEST 1 OF NORMAL CONTROL AND NORMAL EXPERIMENTAL GROUPS. MENTAL AGE CONTROLLED.

OURCE	df	$\sum x^2$	$\sum y^2$	$\sum xy$	ADJUSTED SUM OF SQUARES	df	MEAN SQUARE	F	P
otal	35	6723.23	28618.56	-5898.11	28101.13	34			
etween Groups	1	81.01	920.11	273.00	6136.09	1	6136.09	9.22	$<.01$
ithin Groups	34	6642.22	27689.45	-6171.11	21965.04	33	665.61		

TABLE XXVII

ANALYSIS OF CO-VARIANCE: TRANSFER TEST SCORES OF NORMAL CONTROL AND NORMAL EXPERIMENTAL GROUPS. MENTAL AGE CONTROLLED.

SOURCE	df	x^2	y^2	xy	ADJUSTED SUM OF SQUARES	df	MEAN SQUARE	F	P
Total	35	6723.23	1108310.80	-52278.17	701808.71	34			
Between Groups	1	81.01	268842.25	-4666.51	103622.74	1	103622.74	5.72	.05
Within Groups	34	6642.22	839468.55	47611.66	598185.97	33	18126.85		

found that the adjusted mean Transfer Test Score for the normal control group was 542.40 seconds as compared to an adjusted mean of 369.77 seconds for the normal experimental group. The difference between the adjusted means for the two groups was 172.63 seconds which was significant at the 5 percent level of confidence.

Similar results were obtained for the mentally handicapped control and mentally handicapped experimental groups. The pertinent data appear in Table XXVIII. The F-ratio yielded by the co-variance analysis of the final performance on Assembly Test 1 was 4.41. The probability of this value is less than .05. A similar analysis of the performance of the two groups on the Transfer Test Scores resulted in an F-ratio of 20.05. The probability of this F-ratio is less than .001, Table XXIX. The adjusted mean score on the final performance on Assembly Test 1 for

TABLE XXVIII

ANALYSIS OF CO-VARIANCE: FINAL PERFORMANCE SCORES ON ASSEMBLY TEST 1 OF MENTALLY HANDICAPPED CONTROL AND MENTALLY HANDICAPPED EXPERIMENTAL GROUPS. MENTAL AGE CONTROLLED.

SOURCE	df	Σx^2	Σy^2	Σxy	ADJUSTED SUM OF SQUARES	df	MEAN SQUARE	F	P
Total	35	3574.00	92324.56	-822.00	92135.51	34			
Between Groups	1	880.10	7000.11	2482.00	10863.24	1	10863.24	4.41	$<.05$
Within Groups	34	2693.90	85324.45	-3304.00	81272.27	33	2462.80		

TABLE XXIX

ANALYSIS OF CO-VARIANCE: TRANSFER TEST SCORES OF MENTALLY HANDICAPPED CONTROL AND MENTALLY HANDICAPPED EXPERIMENTAL GROUPS. MENTAL AGE CONTROLLED.

SOURCE	df	Σx^2	Σy^2	Σxy	ADJUSTED SUM OF SQUARES	df	MEAN SQUARE	F	P
Total	35	3574.00	1437289.00	-32787.00	1136409.10	34			
Between Groups	1	880.10	619369.00	23347.67	435460.82	1	435460.82	20.50	$<.001$
Within Groups	34	2693.90	817920.00	56134.61	700948.28	33	21240.86		

the mentally handicapped control group was 144.59 seconds as compared to an adjusted mean of 184.63 seconds for the mentally handicapped experimental group. The mentally handicapped control group performed Assembly Test 1 on the final performance 40.84 seconds more rapidly than did the mentally handicapped experimental group. This difference was significant at the 5 percent level of confidence. When the unique (Transfer) task was given to the mentally handicapped groups, however, it was found that the mentally handicapped control group had an adjusted mean Transfer Test Score of 468.84 seconds as compared to an adjusted mean of 412.83 seconds for the mentally handicapped experimental group; thus, there was a difference of 56.01 seconds. This difference was significant at the .001 level of confidence.

It is apparent from an examination of Table XXX that while the normal and mentally handicapped control groups performed the initial (Assembly Test 1) task with 5 days of practice significantly more rapidly than the normal and mentally handicapped experimental groups who had had only 2 days of practice with 3 additional days of intervening tasks, when the unique (Transfer) task was given to all four groups, in both instances the experimental groups performed this task significantly more rapidly than did the contol groups.

Figures 9 and 10 give a graphic picture of what occurred concerning the performance of the normal and mentally handicapped experimental groups on the initial trial, instructional trials, and final trial of Assembly Test 1, and the performance of the normal and mentally handicapped control groups on the initial trial, practice trials, and final trial on Assembly Test 1 (Appendix F). In each

COMPARISON OF FINAL PERFORMANCE ON ASSEMBLY TEST 1 AND TRANSFER TEST SCORES OF NORMAL CONTROL AND EXPERIMENTAL GROUPS AND MENTALLY HANDICAPPED CONTROL AND EXPERIMENTAL GROUPS

	POST-TEST				TRANSFER TEST			
	ADJUSTED MEAN	DIFF.	F	PROBABILITY	ADJUSTED MEAN	DIFF.	F	PROBABILITY
Normal Control	155.94				542.40			
Normal Experimental	168.83	11.89	9.22	<.01	369.77	172.63	5.72	<.05
Mentally Handicapped Control	144.59				468.84			
Mentally Handicapped Experimental	184.63	40.84	4.41	<.05	412.83	56.01	20.50	<.001

instance the solid line indicates the learning curve of the two control groups as they performed the task from the initial trial through four successive days of practice, to the final trial. It will be noted that after an initial rapid rise in performance (reduction in time), the performance began to slow down and to apparently approach a plateau. The dotted line indicates the performance of the two experimental groups on this same item - initial (Trial 1), instruction (Trial 2), and final (Trial 3 four days after Trial 2).

The normal control and experimental groups started out on the first day with initially almost identical mean initial trial scores. The mentally handicapped control and experimental groups were similarly almost identical on the mean initial trial scores. Table XXV indicated

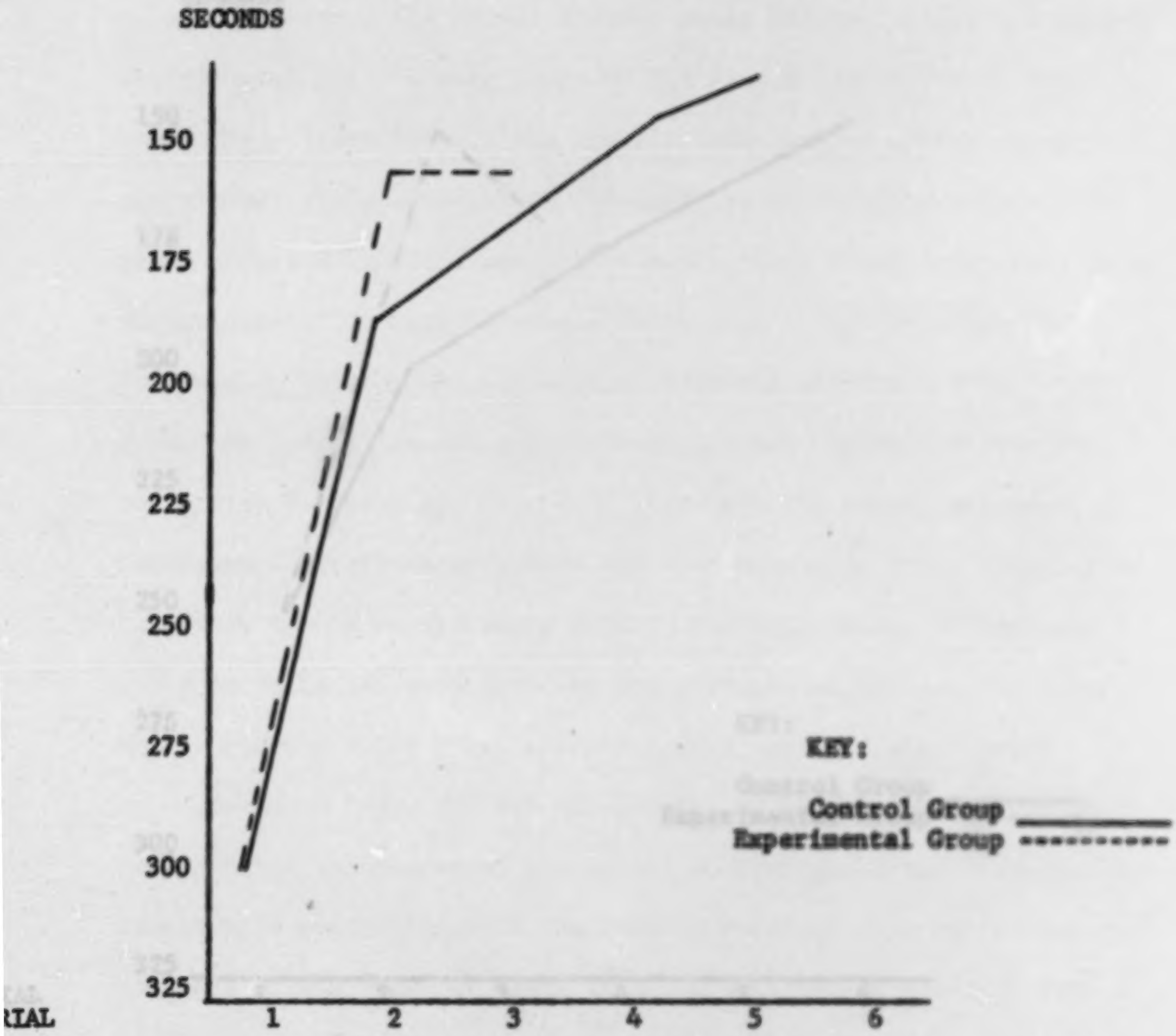


Figure 9

TIME REQUIRED TO PERFORM ASSEMBLY ON ASSEMBLY TASK 1
FOR SUCCESSIVE TRIALS - NORMAL CONTROL
AND EXPERIMENTAL GROUPS.

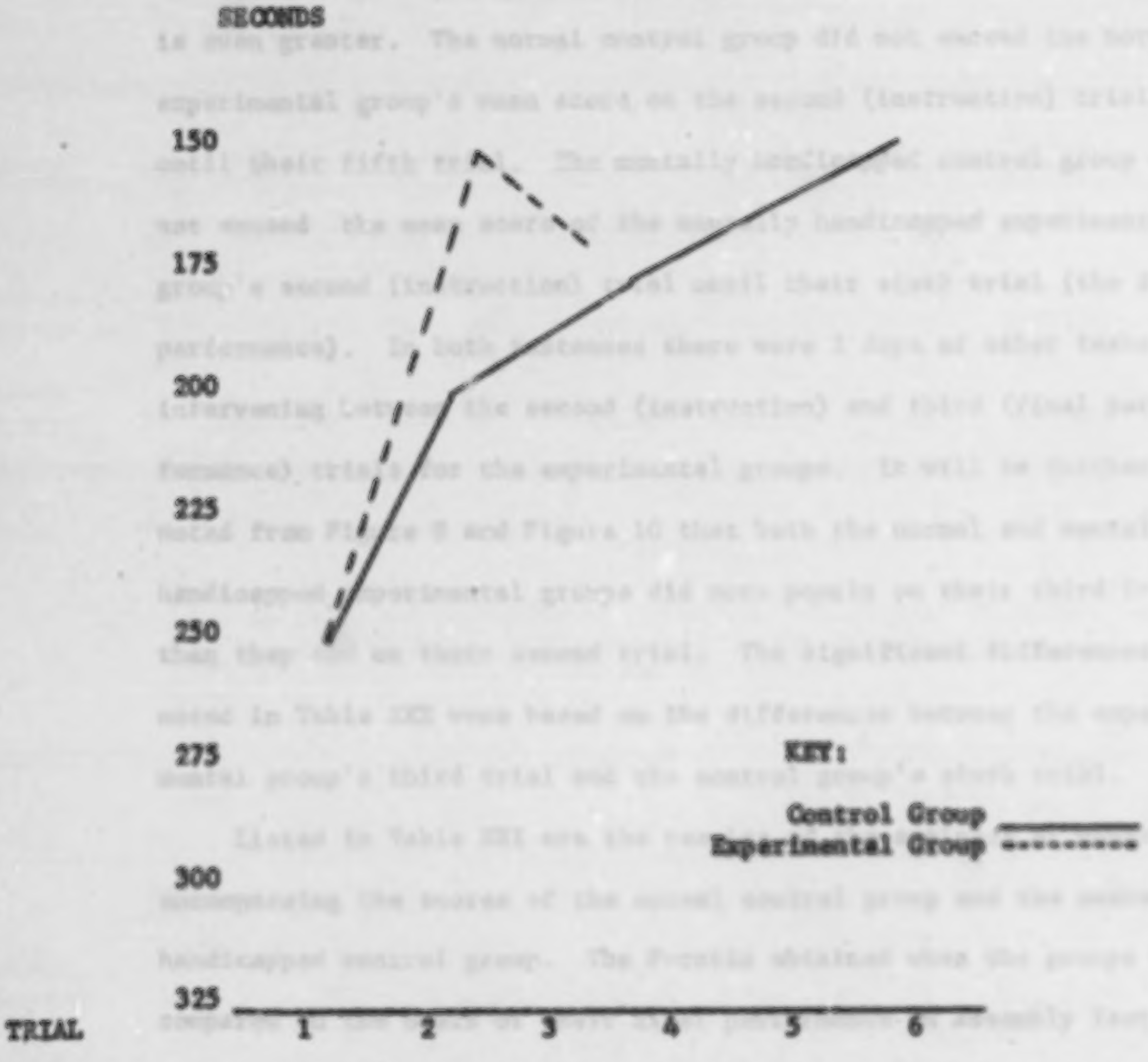


Figure 10

TIME REQUIRED TO PERFORM ASSEMBLY ON ASSEMBLY TASK 1
FOR SUCCESSIVE TRIALS - MENTALLY HANDICAPPED
CONTROL AND EXPERIMENTAL GROUPS.

that the small differences were not statistically significant. While the control groups showed a rapid rise on the second administration of this test item, the rise of the experimental groups in both instances is even greater. The normal control group did not exceed the normal experimental group's mean score on the second (instruction) trial until their fifth trial. The mentally handicapped control group did not exceed the mean score of the mentally handicapped experimental group's second (instruction) trial until their sixth trial (the final performance). In both instances there were 3 days of other tasks intervening between the second (instruction) and third (final performance) trials for the experimental groups. It will be further noted from Figure 9 and Figure 10 that both the normal and mentally handicapped experimental groups did more poorly on their third trial than they did on their second trial. The significant differences noted in Table XXX were based on the differences between the experimental group's third trial and the control group's sixth trial.

Listed in Table XXI are the results of the analyses of co-variance encompassing the scores of the normal control group and the mentally handicapped control group. The F-ratio obtained when the groups were compared on the basis of their final performance on Assembly Test I is 10.16; the associated probability is less than .01. The corresponding values related to performance on the Transfer Test are 31.58 and the probability less than .001, Table XXXII.

TABLE XXXI

ANALYSIS OF CO-VARIANCE: FINAL PERFORMANCE SCORES ON ASSEMBLY TEST 1 OF NORMAL CONTROL AND MENTALLY HANDICAPPED CONTROL GROUPS. MENTAL AGE CONTROLLED.

SOURCE	df	Σx^2	Σy^2	Σxy	ADJUSTED SUM OF SQUARES	df	MEAN SQUARE	F	P
Total	35	7608.31	28514.00	-5975.00	23821.68	34			
Between Groups	1	2652.25	400.00	1030.00	5608.83	1	5608.83	10.16	$<.01$
Within Groups	34	4956.06	28114.00	-7005.00	18212.85	33	551.90		

TABLE XXXII

ANALYSIS OF CO-VARIANCE: TRANSFER TEST SCORES OF NORMAL CONTROL AND MENTALLY HANDICAPPED CONTROL GROUPS. MENTAL AGE CONTROLLED.

SOURCE	df	Σx^2	Σy^2	Σxy	ADJUSTED SUM OF SQUARES	df	MEAN SQUARE	F	P
Total	35	7608.31	1205394.80	46816.75	917347.91	34			
Between Groups	1	2652.25	7832.25	4557.75	80121.74	1	80121.74	31.58	$<.001$
Within Groups	34	4956.06	1197562.55	42259.00	837226.17	33	2537.05		

Table XXXIII shows a comparison of the final performance on Assembly Test 1 and Transfer Test Scores for the normal and mentally handicapped control groups. The mean adjusted final performance score for the normal control group was 169.36 seconds as compared to a mean adjusted final performance score of 138.64 seconds for the mentally handicapped control group. The difference between the two groups was 30.72 seconds, which was significant at the 1 percent level of confidence. The mean adjusted Transfer Test Score for the normal control group was 549.37 seconds. The mean adjusted Transfer Test Score for the mentally handicapped control group was 565.13 seconds - a difference of 31.38 seconds.. This difference was significant at the .001 level of confidence. While the mentally handicapped control group did significantly better than the normal control group after six days of practice on the original test item (Assembly Task 1), it was found that the normal control group did significantly better than the mentally handicapped control group on the unique (Transfer) test

TABLE XXXIII

COMPARISON OF FINAL PERFORMANCE ON ASSEMBLY TEST 1 AND TRANSFER TEST SCORES OF NORMAL AND MENTALLY HANDICAPPED CONTROL GROUPS

	POST-TEST			TRANSFER TEST		
	ADJUSTED MEAN	DIFF.	PROBA-BILITY	ADJUSTED MEAN	DIFF.	PROBA-BILITY
ormal Control	169.36			549.37		
entally Handicapped Control	138.64	30.72	$<.01$	565.13	31.38	$<.001$

used to measure transfer in the experimental groups. This would indicate that the factor of age and maturation did not apparently enter significantly into the achievement of the test items being used although the mentally handicapped children were older than the normal children and on this basis one might have thought they should, therefore, have scored higher than the normal children in both the practice and the unique or Transfer task.

In Table XXXIV appear the data pertaining to the co-variance analyses of the performance of the mentally handicapped experimental group and the normal experimental group. The comparison of the groups in terms of their final performance on Assembly Task I yielded an F-ratio of .08. The probability of this F is greater than .05. The F-ratio of 5.47 (Table XXXV), which resulted from an analysis of the Transfer Test scores of the two experimental groups, has a probability of less than .05.

TABLE XXXIV

ANALYSIS OF CO-VARIANCE: FINAL PERFORMANCE SCORES ON
ASSEMBLY TEST 1 OF NORMAL EXPERIMENTAL AND
MENTALLY HANDICAPPED EXPERIMENTAL GROUPS.
MENTAL AGE CONTROLLED.

OURCE	df	$\sum x^2$	$\sum y^2$	$\sum xy$	ADJUSTED SUM OF SQUARES	df	MEAN SQUARE	F	P
otal	35	5330.75	86020.00	-3498.00	83724.64	34			
etween Groups	1	960.69	1111.1	-1027.78	208.87	1	208.87	.08	>.05
ithin Groups	34	4380.06	84908.90	-2470.22	83515.77	33	2561.08		

TABLE XXXV

ANALYSIS OF CO-VARIANCE: TRANSFER TEST SCORES OF NORMAL EXPERIMENTAL AND MENTALLY HANDICAPPED EXPERIMENTAL GROUPS. MENTAL AGE CONTROLLED.

	df	$\sum x^2$	$\sum y^2$	$\sum xy$	ADJUSTED SUM OF SQUARES	df	MEAN SQUARE	F	P
Total	35	5330.75	49222.60	-9242.00	476203.01	34			
Between Groups	1	950.69	32400.00	5750.00	67691.48	1	67691.48	5.47	$<.05$
Within Groups	34	4380.06	459826.00	-14992.00	408511.62	33	12379.14		

Subsequent more discrete analysis revealed that while the normal control group performed significantly higher on the unique or Transfer Task than did the mentally handicapped control group, the opposite was found to be true for the normal and mentally handicapped experimental groups (Table XXXVI). Here it was found that the normal experimental

TABLE XXXVI

COMPARISON OF FINAL PERFORMANCE ON ASSEMBLY TEST 1 AND TRANSFER TEST SCORES OF NORMAL AND MENTALLY HANDICAPPED EXPERIMENTAL GROUPS

	POST-TEST			TRANSFER TEST		
	ADJUSTED MEAN	DIFF.	PROBA-BILITY	ADJUSTED MEAN	DIFF.	PROBA-BILITY
Normal Experimental	170.32			387.25		
Mentally Handicapped Experimental	175.67	5.35	$>.05$	292.09	95.16	$<.05$

group had an adjusted mean score on the final performance of Assembly Test 1 5.35 seconds lower than the adjusted mean score of the mentally handicapped experimental group. This difference was not significant. The mentally handicapped experimental group, however, had an adjusted mean score 95.16 seconds lower than the adjusted mean score of the normal experimental group on the Transfer task. This difference was significant at the 5 percent level of confidence, indicating that a significantly larger or greater amount of transfer occurred for the mentally handicapped experimental group than for the normal experimental group.

SUMMARY

Thirty-six normal and thirty-six mentally handicapped children were selected from regular grades and special classes within the public schools. Normal control and experimental and mentally handicapped control and experimental groups were formed. The mean I.Q.'s of the normal control and experimental groups were 103.77 and 106.11, respectively. The mean I.Q.'s of the mentally handicapped groups were 69.72 and 69.17, respectively.

Three hypotheses were to be tested. The first hypothesis was, "A group of normal children will be able to apply a principle learned to a unique task to a greater extent than a group of normal children of the same mental age who have not had the principle taught to them." When a unique (Transfer) task, which neither the normal control nor the normal experimental group had previously seen, was given to them, it was found that the performance of the experimental group was significantly better than the performance of the control group at the 5 percent level of confidence. The hypothesis, therefore, could not be rejected.

The second hypothesis to be tested was, "A group of mentally handicapped children will be able to apply a principle learned to a unique task to a greater extent than a group of mentally handicapped children of the same mental age who have not had the principle taught to them." It was found that the mentally handicapped experimental group performed a unique (Transfer) task significantly faster (at the .001 level of confidence) than the mentally handicapped control group. The hypothesis could not be rejected.

The third hypothesis to be tested was, "Normal and mentally handicapped children of the same mental age will have the same ability to generalize or apply a common principle to a unique task (transfer)." It was found that the mentally handicapped experimental group did significantly better (at the 5 percent level of confidence) than the normal experimental group on the unique or Transfer task. The hypothesis that there was no difference in the ability to transfer between normal and mentally handicapped groups of the same mental age was, therefore, rejected.

CHAPTER VI

REASONING

PROCEDURE

Twenty-five normal children and twenty-five mentally handicapped children were selected from public school regular and special classes to be used as subjects in the study (Table XXXVII). Each group contained 9 girls and 16 boys. The chronological ages of the children in the normal group ranged from 99 months to 117 months with a mean of 107.12 months. The chronological ages of the mentally handicapped children ranged from 127 months to 194 months with a mean of 155 months. The difference between the mean chronological ages of the normal and mentally handicapped groups was 47.88 months. The intelligence quotients of the normal group ranged from 90 to 113 with a mean of 100.16 as

TABLE XXXVII

MEANS AND DISTRIBUTIONS OF CHRONOLOGICAL AGES, MENTAL AGES, AND INTELLIGENCE QUOTIENTS OF NORMAL AND MENTALLY HANDICAPPED GROUPS

	NORMAL			MENTALLY HANDICAPPED					
	N	M(months)	σ	N	M(months)	σ	DIFFERENCE	t	PROBABILITY
A. ange	25	107.12 (99-117)	5.35	25	155.00 (127-194)	19.98	47.88	11.346	<.001
A. nge	25	107.36 (88-125)	10.17	25	106.52 (85-127)	11.02	0.84	.274	>.05
Q. nge	25	100.16 (90-113)	7.30	25	70.40 (55-77)	6.13	29.76	15.261	<.001

compared to a range in intelligence quotients from 55 to 77 with a mean of 70.40 for the mentally handicapped group. The difference between the mean I.Q.'s of the two groups was 29.76.

The two groups were matched on the basis of mental age. The mental ages of the normal children ranged from 88 months to 125 months with a mean of 107.36 months. The mental ages of the mentally handicapped children ranged from 85 months to 127 months with a mean of 106.52 months. The difference between the mean mental ages of the two groups was 0.84 months; this was not statistically significant.

A reasoning test (Appendix G) consisting of 5 subtests containing 10 items each was administered to each child in the two groups in group situations. Each of the 5 subtests could be answered correctly by solving the single analogies principle upon which the 10 items were based. The objective was to determine how well the children could determine the principle and thus indicate the correct response. The principle followed in subtest "1" was that of identical form. The principle followed in subtest "2" was size relationship (large to small). The principle followed in subtest "3" was direction (horizontal to vertical, and so forth). The principle followed in subtest "4" was straight line to curved line, and the principle followed in subtest "5" was reversal of elements (for example, a circle within a square is to a square within a circle as a triangle within a circle is to: A triangle within a circle, a square within a triangle, or a circle within a triangle -- the correct answer being a circle within a triangle.)

The directions used in the administration of the 5 subtests were as follows: "Look at No. 1". (Figure 11). The instructor, using his finger, then pointed out the analogy while saying, "This (pointing

"1"

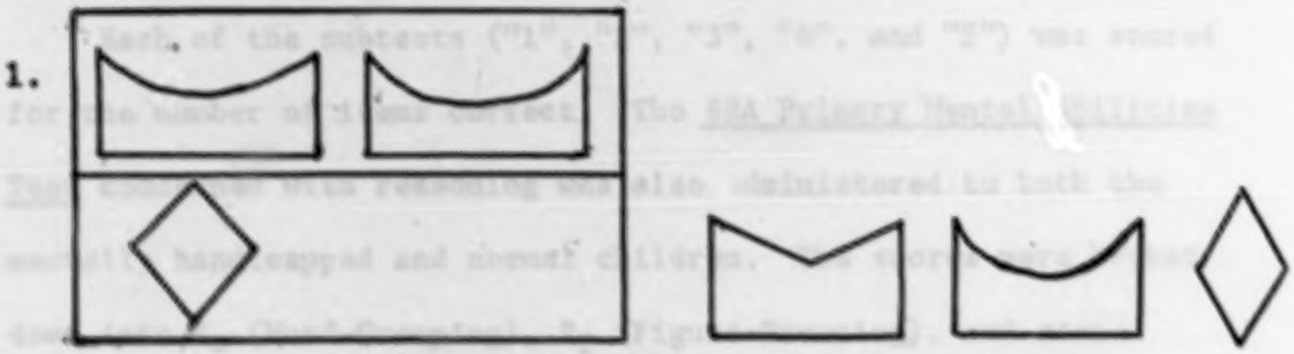


Figure 11

FIRST ITEM OF REASONING SUBTEST "1"

at the upper left-hand figure) goes with this one (pointing at the upper right-hand figure) as this (pointing at the lower left-hand figure) goes with.....which one of these 3 (pointing)? Don't tell me! Draw a cross over the one that should be in the empty space (pointing). Put your pencil down."

After the children had made their selection, the examiner indicated which one was the correct response but did not allow the children to change their response. The same procedure was followed for items 2, 3, 4, and 5. After completing item 5, the children were told to select the correct item for each one of the 5 items on the following page, numbers 6 through 10. The same procedure was followed for subtests "2", "3", "4", and "5". The children were informed as to whether or not each of their first 5 items were correct in each subtest and then finished the last 5 items independently. The purpose of using this method of administration was to aid the children in arriving at the analogies principle used without actually informing them as to what the principle was.

Each of the subtests ("1", "2", "3", "4", and "5") was scored for the number of items correct. The SRA Primary Mental Abilities Test concerned with reasoning was also administered to both the mentally handicapped and normal children. The scores were broken down into R_w (Word-Grouping), R_f (Figure-Grouping), and scored according to the directions of the test. Thus, the 5 analogies reasoning tests and the reasoning tests of the SRA Primary Mental Abilities were used in comparing the reasoning ability of the normal and mentally handicapped groups of children.

RESULTS

It was found that there were no statistically significant differences between the mean total reasoning by analogy scores, partial scores, and number of reasoning principles learned by the normal and mentally handicapped groups (Table XXXVIII). The average number of items marked correctly in the 5 subtests (out of a possible 50) by the normal children was 25.88 with a range from 14 to 45 as compared to an average of 24.24 (with a range from 11 to 40) for the mentally handicapped children. The difference between the means was not significant.

TABLE XXXVIII

MEANS AND DISTRIBUTIONS OF TOTAL REASONING SCORES, PARTIAL REASONING SCORES (SUBTESTS "1", "2", and "5"), AND NUMBER OF PRINCIPLES LEARNED FOR NORMAL AND MENTALLY HANDICAPPED GROUPS

	NORMAL			MENTALLY HANDICAPPED			DIFFERENCE	t	PROBABILITY
	N	M	σ	N	M	σ			
Total Score	25	25.88	6.10	25	24.24	7.55	1.64	0.84	>.05
Range		(14-45)			(11-40)				
Partial Score	25	18.76	3.47	25	17.24	4.96	1.52	1.26	>.05
Range		(12-27)			(9-28)				
Principles Learned	25	2.48	1.00	25	1.96	1.21	0.52	1.66	>.05

A careful examination was then made of the individual responses on the 5 subtests and it appeared that by and large both the normal and mentally handicapped groups tended to guess on subtests "3" and "4". A re-evaluation was then made using only the responses on subtests "1", "2", and "5" to determine whether or not there were any differences between the normal and mentally handicapped groups of children on these. The mean partial reasoning score of the normal group was 18.76 with a range from 12 to 27. The mean partial score of the mentally handicapped group was 17.24 with a range from 9 to 28. Again the difference of 1.52 was not statistically significant.

Each of the subtests for each child was then judged as to whether or not the principle (rule of relationship) had been discovered. The criteria used was (1) more than 5 correct responses, 3 of them being in consecutive order, and (2) in marginal cases (4 or 5 correct responses) consideration was given as to whether or not the items passed or failed were "difficult" or "easy" items on the basis of the total group performance. In addition, subjects were not given credit for the discovery of a principle when there was evidence of a consistent use of a partial or incorrect relationship that could not have been applied to all the items in that subtest. For example, marking all straight line choices on subtest "4" did not apply to all the items and did not follow the analogy involved.

It was found that the normal children discovered an average of 2.48 principles (out of a possible 5) as compared to an average of 1.96 principles for the mentally handicapped group. The difference of 0.52 was not statistically significant, however.

Next, a comparison of the SRA Primary Mental Abilities R_w (Word-Grouping) and R_f (Figure-Grouping) scores of the normal and mentally handicapped groups was made (Table XXXIX). The mean R_w score for the

TABLE XXXIX

MEANS AND DISTRIBUTIONS OF SRA PRIMARY MENTAL ABILITIES R_w (WORD-GROUPING) AND R_f (FIGURE-GROUPING) SCORES OF NORMAL AND MENTALLY HANDICAPPED GROUPS

	NORMAL			MENTALLY HANDICAPPED					PROBA-BILITY
	N	M	σ	N	M	σ	DIFFERENCE	t	
	25	104.92	15.24	25	101.64	17.38	3.28	0.71	>.05
Range		(75-130)			(76-141)				
	25	111.76	17.01	25	107.52	26.25	4.24	0.68	>.05
Range		(77-134)			(71-158)				

normal group was 104.92 with a range from 75 to 130. The mean R_w score for the mentally handicapped group was 101.64 with a range from

76 to 141. The difference of 3.28 was not statistically significant. Similarly, the difference between the means of the normal and mentally handicapped group of 4.24 for the R_f scores was not statistically significant. The mean R_f score for the normal group was 111.76 with a range from 77 to 134 and for the mentally handicapped group was 107.52 with a range from 71 to 158.

Inasmuch as none of the differences had proved to have any significance, it was thought that possibly the reasoning by analogies and the SRA Primary Mental Abilities R_f test might have a high correlation and be essentially testing the same thing. Correlations of the total and partial reasoning scores with the SRA Primary Mental Abilities R_f scores were computed for the normal, mentally handicapped, and combined normal and mentally handicapped groups (Table XXXX). The

TABLE XXXX

CORRELATIONS OF TOTAL AND PARTIAL (SUBTESTS "1", "2", AND "5") REASONING SCORES WITH SRA PRIMARY MENTAL ABILITIES R_f (FIGURE-GROUPING) SCORES FOR NORMAL, MENTALLY HANDICAPPED, AND COMBINED NORMAL AND MENTALLY HANDICAPPED GROUPS

	N	PMA R_f M		REASONING TOTAL M		REASONING PARTIAL M		r	PROBABILITY
Normal	25	111.76	17.01	25.88	6.10			.22	>.05
Normal	25	111.76	17.01			18.76	3.47	.39	>.05
Mentally Handicapped	25	107.52	26.25	24.24	7.55			.06	>.05
Mentally Handicapped	25	107.52	26.25			17.24	4.96	.16	>.05
Normal and Mentally Handicapped	50	109.64	21.77			18.00	4.26	.24	>.05

correlations were all small, ranging from .06 to .39. None of them were statistically significant.

SUMMARY

Twenty-five normal and twenty-five mentally handicapped children were selected from public school regular and special classes. Each child was given a reasoning by analogies test and the reasoning tests of the SRA Primary Mental Abilities Test. Correlations between the reasoning by analogies tests and the one of the reasoning sections (R_f - Figure-Grouping) of the SRA Primary Mental Abilities Test were calculated. The correlations were not significant, indicating the tests were not measuring the same factors.

The hypothesis tested was, "Normal and mentally handicapped groups of children of the same mental age will show the same ability to perform on a task in which they are required to reason or discover a principle." Three tests of reasoning were used - reasoning by analogy, SRA Primary Mental Abilities R_w (Word-Grouping) and SRA Primary Mental Abilities R_f (Figure-Grouping). While the normal group scored consistently higher on all measures (total analogies, partial analogies, principles learned, R_w, and R_f), in no instance was the difference between the mean scores of the two groups significant. The hypothesis, therefore, could not be rejected.

CHAPTER VII

SUMMARY AND DISCUSSION

Persons who have worked with retarded individuals have expressed many opinions concerning their learning characteristics, often with relatively little in the way of supportive research evidence or data. Statements have often been made based on subjective observation alone. When these statements have been made by persons accepted as authorities in the field, they have often become the basis for the development of programs, particularly for the educable or mentally handicapped group.

A survey of research concerning the learning characteristics of the mentally retarded brings out a number of problems. First, in attempting to evaluate the implications of the research, one is almost immediately struck with the lack of agreement concerning the terminology used by the various investigators. Thus, it becomes extremely difficult for the reader to assess accurately the group of retarded individuals for whom these findings are applicable. Second, much of the reported research has been carried out with institutionalized groups of retarded children. Children housed within institutions are not only living in a unique environment but also initially represent a skewed distribution of the total population of retardates. They are usually committed for reasons other than their mental retardation; that is, their problems have been brought to the attention of authorities as a result of dependency or behavioral deviations so that there is an overlay of psychological problems in addition to the mental retardation. What effect these psychological problems have in regard to the children's performance on learning tasks is difficult to specifically determine and divorce or factor out from the effect of the mental retardation. Consequently, it is difficult, if at all possible, to draw generalizations applying to the retarded population as a whole from data obtained from such a restricted and biased sample. Third, when the research is examined carefully in its totality, one is particularly aware of the restricted number of studies and the restricted nature of the studies that are available.

The objective of the present studies was to obtain a more accurate evaluation of some of the learning characteristics of mentally handicapped children who had been placed in special classes within the community so more would be known concerning this aspect of their development. A series of 4 studies was selected that were designed to measure: (1) Memorization, Recognition, Recall, and Savings; (2) Proactive and Retroactive Inhibition; (3) Ability to generalize or apply a common principle to a unique task (Transfer); and (4) Reasoning.

The major hypothesis to be tested was that there are no differences between the learning characteristics of normal and mentally handicapped groups of children of the same mental age. As a result of the data that were collected and analyzed, it was impossible to either accept or reject the above hypothesis.

Both the normal and mentally handicapped groups showed consistently better or faster learning of 6 nonsense syllables from Learning Trial I to Trials II and III (Table XXXXI). The differences

TABLE XXXXI

MEANS AND DISTRIBUTIONS OF LEARNING TRIALS I, II, AND III FOR NORMAL AND MENTALLY HANDICAPPED GROUPS
N = 30

	LEARNING I		LEARNING II				PROBA-
	M	σ	M	σ	D/MEAN	t	BILITY
Normal	22.20	8.38	6.30	4.32	15.90	9.14	$<.001$
Mentally Handicapped	18.70	5.57	6.57	3.26	12.13	10.19	$<.001$

	LEARNING II		LEARNING III				PROBA-
	M	σ	M	σ	D/MEAN	t	BILITY
Normal	6.30	4.32	4.38	2.00	1.47	1.63	$>.05$
Mentally Handicapped	6.57	3.26	3.67	1.29	2.90	7.16	$<.001$

in numbers of repetitions required were significant for the mentally handicapped group between Trials I and II and Trials II and III. The difference in number of repetitions between Learning Trials I and II for the normal group was significant but the difference between Trials II and III was not.

To further test the value of the "relearning", tests of significance were calculated between the scores obtained on Recognition I and II, Error I and II, Accuracy of Recognition I and II, and Recall I and II for the normal and mentally handicapped groups (Table XXXXII). Improvement was shown in all areas of recognition and recall measured, although significant improvement was found only between Error I and II and Recall I and II for the normal group and between Recall I and II for the mentally handicapped group. The

TABLE XXXXII

MEANS AND DISTRIBUTIONS OF RECOGNITION I AND II, ERROR I AND II, ACCURACY OF RECOGNITION I AND II, AND RECALL I AND II FOR NORMAL AND MENTALLY HANDICAPPED GROUPS

N = 30

	RECOGNITION I		RECOGNITION II				PROBA-BILITY
	M	σ	M	σ	D/MEAN	t	
Normal	4.70	1.27	4.93	1.06	0.23	0.75	$>.05$
Mentally Handicapped	3.73	1.36	4.13	1.55	0.40	1.32	$>.05$
	ERROR I		ERROR II				PROBA-BILITY
	M	σ	M	σ	D/MEAN	t	
Normal	3.40	3.22	2.27	2.30	1.10	2.19	$<.05$
Mentally Handicapped	3.63	3.17	2.77	2.37	0.86	1.17	$>.05$
	ACC. OF REC. I		ACC. OF REC. II				PROBA-BILITY
	M	σ	M	σ	D/MEAN	t	
Normal	72.63	22.68	78.40	20.33	5.77	1.03	$>.05$
Mentally Handicapped	56.60	26.58	64.53	27.85	7.93	1.11	$>.05$
	RECALL I		RECALL II				PROBA-BILITY
	M	σ	M	σ	D/MEAN	t	
Normal	2.57	1.94	3.90	1.96	1.33	2.62	$<.02$
Mentally Handicapped	1.83	1.58	3.63	1.95	1.80	3.90	$<.01$

importance and value of review learning in speed with which the material is mastered (Table XXXXI) and resulting increased recognition, accuracy of recognition, recall, and reduction of errors (Table XXXXII) for both normal and mentally handicapped children seems to be illustrated, not by consistent statistical differences but, by the fact that differences exist for each of the tests made.

No statistically significant differences were found between the normal and mentally handicapped groups in the following areas:

(1) There were no differences between the *Memorization* characteristics, the *Recall* characteristics, or the *Savings* characteristics of normal and mentally handicapped groups of children of the same mental age.

(2) In testing the hypothesis that normal and mentally handicapped groups of children of the same mental age would show the same ability to perform on a task in which reasoning or the discovery of a principle was required, 3 tests were used; reasoning by analogy, the SRA PMA R_w (Word-Grouping) and the SRA PMA R_f (Figure-Grouping). In no instances were the differences between the mean scores of the 2 groups significant, so the hypothesis was rejected and no differences were found.

In regard to the *Recognition* characteristics of the normal and mentally handicapped groups of children, three tests were used to obtain the necessary information consisting of the number of syllables recognized, the number of errors made in recognition, and the accuracy of recognition. It was found that the normal children recognized a significantly larger number of syllables following both Trial I and Trial II than the mentally handicapped children. Since on only one of the three tests was any statistically significant difference found between the scores of the two groups, the hypothesis that there are no differences between the recognition characteristics of normal and mentally handicapped groups of children of the same mental age could neither be accepted nor rejected.

On the basis of the data collected, the hypotheses that normal and mentally handicapped children would show no differences concerning the affect of previous learnings on subsequent learnings could not be rejected. In both instances it was found that Proactive Inhibition was operating and affecting the learning of the second task. However, it was found that on the tasks used, the normal group was significantly more affected by the previously learned material than were the mentally handicapped children. The hypothesis that with normal children, when the learning of a task is interrupted by the learning of a similar task, the completion of the learning of the original task will be affected could not be rejected on the basis of the data. However, the data did not support the hypothesis that the same would be true for mentally handicapped children. As with Proactive Inhibition, it was found that the mentally handicapped experimental and normal experimental groups differed in their learning scores on the final task significantly, the mentally handicapped children being significantly less affected by interrupting the learning of a task by the learning of a task of a similar nature, and the hypothesis that there will be no differences between the learning of normal and mentally handicapped groups of children of the same mental age was rejected.

Difference between the mentally handicapped and normal groups was also found in the area of Generalization or the ability to transfer a principle to a new or unique task. It was found that both the normal and the mentally handicapped groups of children were able to apply a principle learned to a unique task but on the basis of the data obtained, the hypothesis that normal and mentally handicapped children of the same mental age will have the same ability to apply a common principle to a unique task (Transfer) was rejected. The mentally handicapped children showed significantly greater ability to transfer.

Four studies concerning the ability to (1) Memorize, Recognize, Recall, and Save; (2) evaluate the effect of Retroactive and Proactive Inhibition; (3) ability to Generalize or transfer a principle; and (4) ability to Reason were conducted with normal and mentally handicapped groups. It was found that the normal and mentally handicapped groups did not differ significantly in their abilities of memorization, recognition, recall, or savings and in their ability to reason. Significant differences were found between the normal and mentally handicapped groups in regard to the effects of retroactive and proactive inhibition upon learning and in their ability to generalize or transfer a principle. It was found that the mentally handicapped children were less affected by proactive and retroactive inhibition and showed greater ability to generalize or transfer a principle to a new or unique task.

The present series of studies are were largely theoretical in nature and should be followed up with a parallel series concerned with tasks involving academic learnings. If similar kinds of results are then obtained, the findings will have many implications for planning curriculums and instruction for mentally handicapped children. In addition, the learning processes involved in reading and arithmetic (as well as other skills taught in school) should be carefully analyzed. Additional theoretical learning studies should then be carried out to determine the comparative abilities of normal and mentally handicapped children of the same mental age upon these characteristics. Only with a fund of this kind of information can an intelligent approach be made to the problem of program planning and instruction.

The present studies, *if supported by supplementary research concerned with the specific tasks involved*, could have the following kinds of educational implications:

1. Mentally handicapped children should be reading at their Binet or Verbal M.A. level since they are able to perform as well as normal children of the same mental age on some of the kinds of learning considered to be involved in reading.
2. It was concluded that The *learning rate* of mentally handicapped children is at least *equal* to that of normal children of the same mental age of developmental level. The *rate or development is slower* for the mentally handicapped, Figure 12. Thus a group of mentally handicapped children starting at the same developmental level as a group of normal children will be able to learn specific skills at that developmental level

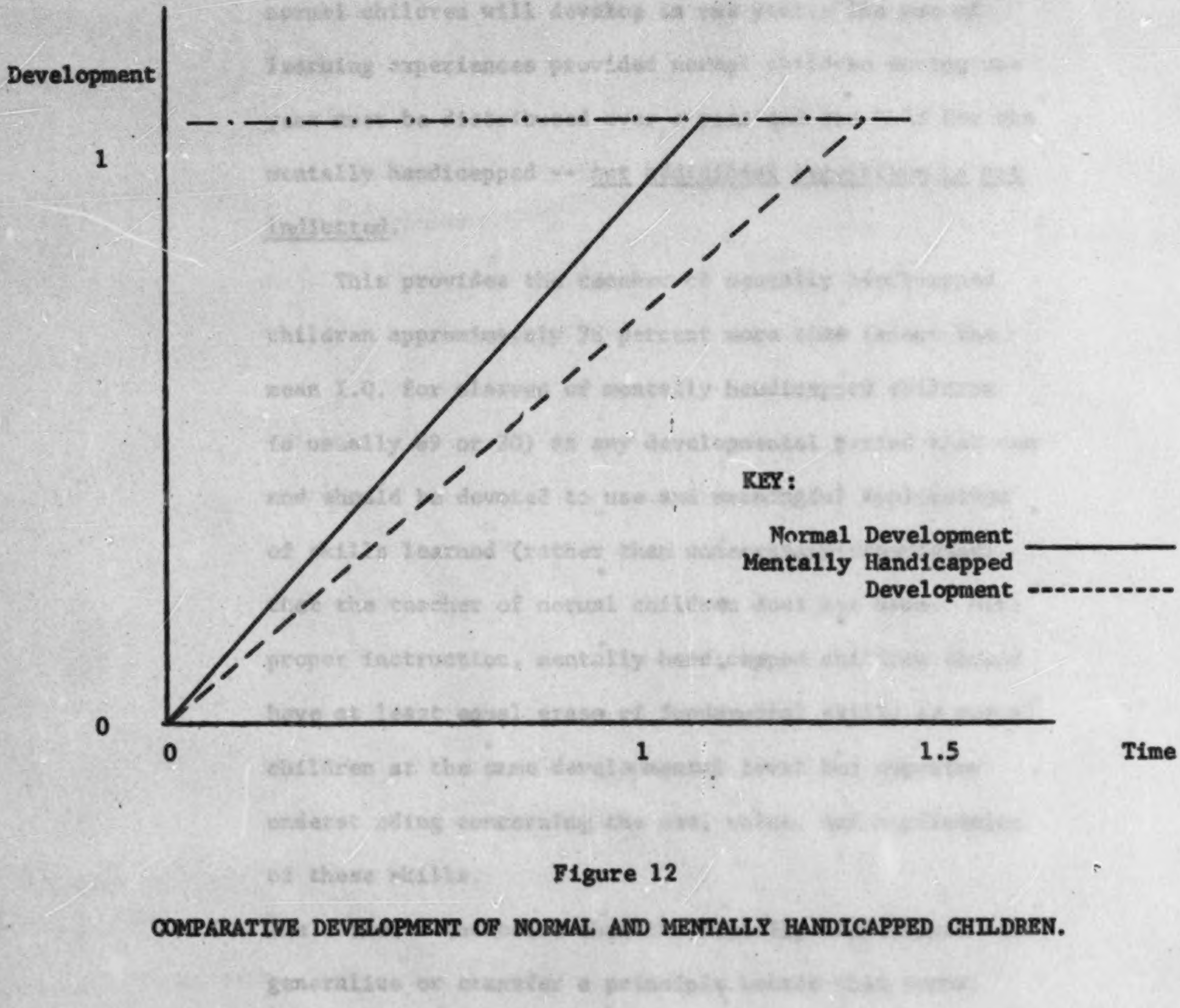


Figure 12

COMPARATIVE DEVELOPMENT OF NORMAL AND MENTALLY HANDICAPPED CHILDREN.

at least equally well and with equal rapidity. However, it will take the mentally handicapped group approximately a year and one-half to develop intellectually the same amount normal children will develop in one year. The sum of learning experiences provided normal children during one year must be distributed over a year and one-half for the mentally handicapped -- but additional repetition is not indicated.

This provides the teacher of mentally handicapped children approximately 33 percent more time (since the mean I.Q. for classes of mentally handicapped children is usually 69 or 70) at any developmental period that can and should be devoted to use and meaningful application of skills learned (rather than unnecessary repetition) that the teacher of normal children does not have. With proper instruction, mentally handicapped children should have at least equal grasp of fundamental skills as normal children at the same developmental level but superior understanding concerning the use, value, and application of these skills.

3. The evidence indicates that the mentally handicapped can generalize or transfer a principle better than normal children of the same mental age. The important thing is that they can transfer principles where much instruction is presently based upon transfer of identical elements only.

> The necessity for the inclusion of specific living and working experience in the classroom for the purpose of teaching mentally handicapped children to use this skill in identical or nearly identical situations in the community is definitely not indicated. Much instruction in all areas of academic, social, and vocational skills should be that of teaching principles (how to use reading, how to get along in society, and how to do a job) that can and then will be applied to many and varied situations in which they are applicable. Specific tasks are required within the classroom but not for the purpose of learning that specific one but rather how to apply skills (academic, social, and vocational) to many and varied situations.
>
> It then follows that it is not important to learn to become a bus boy, a filling station attendant, or a tray girl. It is important to learn the basic, fundamental skills required in these and other situations and how to apply the skills where needed. Adjustable rather than adjusted persons should be the objective of a program for the mentally handicapped.

These are only a few of the kinds of applications of research findings of the present studies when they are extended to and supplemented by studies to include more kinds of learning and others containing more specifically the skills relating to instruction in school.

APPENDICES

APPENDIX A

NONSENSE SYLLABLES

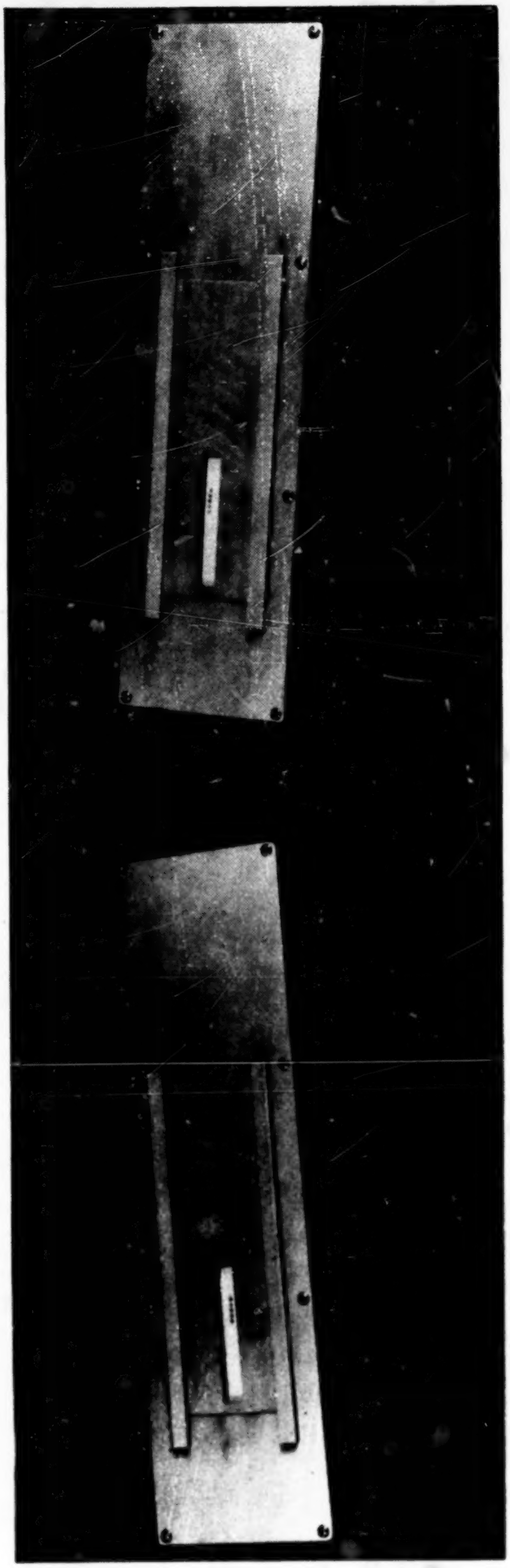
The six nonsense syllables used were: NAF, PIM, TEV, MIB, YEK, and BUP.

They were selected on the basis of (1) ease of pronunciation, (2) lack of association with an English word or an object, (3) each starting with a different consonant, and (4) each ending with a different consonant. Only the consonants P and M were used twice (one at the beginning and one at the ending of the syllable). Where it was necessary to use a consonant twice (P and M), the syllables containing them were separated by at least one other syllable.

Selection of syllables for each of pronunciation and lack of association was made upon the judgment of experienced professors of speech and psychology.

APPENDIX B

MEMORY DRUM



APPENDIX C

RECOGNITION TEST

NAME____________________DATE__________TEST#______EXAMINER__________

I	II	III	IV	V	VI
1. MAB	MUP	FEN	KAY	PAM	LEP
2. LUK	PEB	NAF	YEV	YEF	TIV
3. MIB	FUT	BEP	SIB	MOP	YAF
4. YEL	YEL	NIF	TEK	BAF	VET
5. DAP	NID	TUV	DIN	PIM	KIN
6. BIM	PUB	NAB	TUY	WEB	TEP
7. FAD	BEP	TOK	YEK	PIV	VIT
8. MIF	NAL	PAF	CAD	VAD	MEV
9. LAN	TED	YIM	KEY	BIM	YIN
10. PED	BUF	FAN	YUK	ZAK	BAP
11. YIB	JET	PEB	FID	BOF	TEV
12. BEM	BUP	VIK	HUP	MIP	ZOP

APPENDIX D

INITIAL AND FINAL TASKS

RETROACTIVE INHIBITION

INITIAL TASK

Name______________________________

Date______________________________

School______________________________

Score:

	1	2	3	4	5	6	7	8	9	10
Raw										
% Correct										

Examiner______________________________________

PRACTICE PAGE

A	B	C	D	E	F	G	H	I
2	9	4	1	7	5	3	8	6

G	F	B	A	C	I	H	F	D

STOP

DO NOT TURN THIS PAGE

A	B	C	D	E	F	G	H	I
2	9	4	1	7	5	3	8	6

A	E	C	H	I	A	B	H	E

B	H	B	A	G	C	F	H	D

G	H	D	C	D	E	G	H	D

D	F	I	E	B	C	G	A	F

B	C	D	A	F	H	C	H	F

H	I	A	D	B	C	I	D	E

F	G	E	A	I	D	C	A	H

H	F	A	G	H	C	A	F	B

B	F	D	G	C	B	F	I	G

STOP

Total ☐

A	B	C	D	E	F	G	H	I
2	9	4	1	7	5	3	8	6

B	F	D	G	A	F	G	C	I

I	C	D	B	G	F	E	B	H

G	A	H	D	F	H	D	G	F

B	H	I	E	D	I	B	C	H

G	H	A	B	I	A	F	D	B

E	A	B	H	E	I	A	D	H

F	D	I	A	I	E	B	C	G

I	A	C	F	D	I	H	G	D

F	A	D	B	H	I	E	B	H

STOP

Total ☐

A	B	C	D	E	F	G	H	I
2	9	4	1	7	5	3	8	6

E	A	H	G	I	H	B	C	D

D	E	F	D	G	A	I	D	B

F	E	I	E	H	C	B	I	F

F	E	H	I	B	F	I	A	C

B	D	H	G	I	E	I	C	H

A	B	E	H	F	C	F	G	F

D	I	D	G	B	H	C	F	D

B	A	C	A	F	E	I	B	D

D	G	E	H	A	I	C	A	G

STOP

Total ☐

A	B	C	D	E	F	G	H	I
2	9	4	1	7	5	3	8	6

D	H	I	A	C	G	D	F	C

G	A	B	G	H	E	G	F	I

F	D	A	C	H	B	H	I	B

C	F	D	F	E	A	B	G	H

B	D	C	F	I	G	E	D	B

I	E	B	D	F	H	A	D	F

B	D	A	E	A	G	C	D	H

C	H	B	I	G	F	E	H	B

D	I	A	C	G	D	B	H	F

STOP

Total ☐

A	B	C	D	E	F	G	H	I
2	9	4	1	7	5	3	8	6

D	I	A	H	F	G	H	B	C

H	A	D	E	B	E	C	G	F

E	D	B	A	D	I	F	H	C

I	B	I	C	A	G	E	G	H

F	A	C	E	B	I	D	B	A

H	D	F	A	B	G	D	H	E

C	I	A	H	E	H	F	G	I

F	A	H	E	A	B	G	B	E

D	I	A	H	B	H	C	F	E

STOP

Total ☐

A	B	C	D	E	F	G	H	I
2	9	4	1	7	5	3	8	6

D	I	C	E	D	C	H	E	B

E	C	D	A	E	A	I	C	E

I	G	D	I	H	B	C	H	E

C	G	I	F	A	I	E	F	D

H	D	C	A	F	E	A	B	A

I	C	D	G	D	F	E	I	C

I	B	E	A	I	D	H	F	H

E	D	I	F	C	A	I	F	C

E	F	A	C	E	D	G	I	F

STOP

Total

A	B	C	D	E	F	G	H	I
2	9	4	1	7	5	3	8	6

E	I	G	A	B	G	C	D	A

E	B	G	D	G	C	I	A	E

C	D	G	B	D	E	H	A	F

B	A	C	B	I	B	F	A	G

H	E	H	B	F	A	B	G	F

A	D	I	F	A	I	H	C	D

E	H	C	I	C	E	G	B	F

D	A	C	A	C	D	F	G	F

D	I	D	A	B	I	E	A	I

STOP

Total

A	B	C	D	E	F	G	H	I
2	9	4	1	7	5	3	8	6

H	I	D	H	B	I	H	D	G

D	B	G	B	H	F	D	G	H

A	D	F	G	C	D	C	B	I

G	I	E	A	C	B	F	A	H

G	B	E	I	B	C	B	D	C

I	B	F	D	A	B	G	F	E

G	C	D	E	G	D	E	C	G

I	G	F	D	E	H	D	B	I

B	D	A	E	G	B	I	E	I

STOP

Total ☐

A	B	C	D	E	F	G	H	I
2	9	4	1	7	5	3	8	6

G	F	A	F	A	I	B	G	B

C	H	A	F	H	A	G	C	G

A	I	B	F	A	E	D	F	C

G	A	H	G	F	G	I	G	C

B	G	F	B	A	F	E	C	G

I	B	C	B	F	E	D	E	C

D	E	C	B	F	I	B	A	D

A	B	C	H	C	E	A	D	C

I	G	C	A	D	B	I	A	E

STOP

Total ☐

A	B	C	D	E	F	G	H	I
2	9	4	1	7	5	3	8	6

G	A	D	E	A	B	C	A	I

G	I	D	A	B	A	D	B	H

B	C	H	G	A	I	H	G	H

G	B	I	E	A	B	G	C	B

I	C	B	E	C	G	F	B	G

I	G	D	C	E	F	E	G	D

H	I	F	H	I	H	C	B	E

G	C	B	E	B	A	B	I	G

E	H	B	I	G	D	B	C	H

STOP

Total ☐

APPENDIX E

INTERPOLATED TASK

RETROACTIVE INHIBITION

INTERPOLATED TASK

Name______________________________

Date______________________________

School______________________________

Score:

	1	2	3	4	5	6	7	8	9	10
Raw										
% Correct										

Examiner______________________________

A	B	C	D	E	F	G	H	I
8	5	2	6	3	1	9	4	7

A	E	C	H	I	A	B	H	E

B	H	B	A	G	C	F	H	D

G	H	D	C	D	E	G	H	D

D	F	I	E	B	C	G	A	F

B	C	D	A	F	H	C	H	F

H	I	A	D	B	C	I	D	E

F	G	E	A	I	D	C	A	H

H	F	A	G	H	C	A	F	B

B	F	D	G	C	B	F	I	G

STOP

Total ☐

A	B	C	D	E	F	G	H	I
8	5	2	6	3	1	9	4	7

B	F	D	G	A	F	G	C	B

I	C	D	B	G	F	D	B	H

G	A	H	B	F	H	D	G	F

B	H	I	E	D	I	B	C	H

G	H	A	B	I	A	F	D	B

E	A	B	H	E	I	A	D	H

F	D	I	A	I	E	B	C	G

I	A	C	F	D	I	H	G	D

F	A	D	B	H	I	E	B	H

STOP

Total ☐

A	B	C	D	E	F	G	H	I
8	5	2	6	3	1	9	4	7

E	A	H	G	I	H	B	C	D

D	E	F	D	G	A	I	D	B

F	E	I	E	H	C	B	I	F

F	E	H	I	B	F	I	A	C

B	D	H	G	I	E	I	C	H

A	B	E	A	F	C	F	G	F

D	I	D	G	B	H	C	F	D

B	A	C	A	F	E	I	B	D

D	G	E	H	A	I	C	A	G

STOP

Total ☐

A	B	C	D	E	F	G	H	I
8	5	2	6	3	1	9	4	7

D	H	I	A	C	G	D	F	C

G	A	B	G	H	E	G	F	I

F	D	A	C	H	B	H	I	B

C	F	D	F	E	A	B	G	H

B	D	C	F	I	G	E	D	B

I	E	B	D	F	H	A	D	F

B	D	A	E	A	G	C	D	H

C	H	D	I	G	F	E	H	B

D	I	A	C	D	G	B	H	F

STOP

Total

A	B	C	D	E	F	G	H	I
8	5	2	6	3	1	9	4	7

D	I	A	H	F	G	H	B	C

H	A	D	E	B	E	C	G	F

E	D	B	A	D	I	F	H	C

I	B	I	C	A	G	E	G	H

F	A	C	E	B	I	D	B	A

H	D	F	A	B	G	D	A	G

C	I	A	H	E	H	F	G	I

F	A	H	E	A	B	G	B	E

D	I	A	H	B	H	C	F	E

STOP

Total ☐

A	B	C	D	E	F	G	H	I
8	5	2	6	3	1	9	4	7

D	I	C	E	D	C	H	E	B

E	C	D	A	E	A	I	C	E

I	G	D	I	H	B	C	H	E

C	G	I	F	A	I	E	F	D

H	D	C	A	F	E	A	B	A

I	C	D	G	D	F	E	I	C

I	B	E	A	I	B	H	F	H

E	B	I	F	C	A	I	F	C

E	F	A	C	E	D	G	I	F

STOP

Total ☐

A	B	C	D	E	F	G	H	I
8	5	2	6	3	1	9	4	7

E	I	G	A	B	G	C	D	A

E	B	G	D	H	C	I	A	E

C	D	G	B	D	E	H	A	F

B	A	C	B	I	B	F	A	G

H	E	H	B	F	A	B	G	F

A	D	I	F	A	I	H	C	D

E	H	C	I	C	E	G	B	F

D	A	C	A	C	D	F	G	F

D	I	D	A	B	I	E	A	I

STOP

Total

A	B	C	D	E	F	G	H	I
8	5	2	6	3	1	9	4	7

H	I	D	H	B	I	H	D	G

D	B	G	B	H	F	D	G	H

A	D	F	G	C	D	C	B	I

G	I	E	A	C	B	F	A	H

G	B	E	I	B	C	B	D	C

I	B	F	D	A	B	G	F	E

G	C	D	E	G	D	E	C	G

I	G	F	D	E	H	E	B	I

B	D	A	E	G	B	I	E	I

STOP

Total ☐

A	B	C	D	E	F	G	H	I
8	5	2	6	3	1	9	4	7

G	F	A	F	A	I	B	G	B

C	H	A	F	H	A	G	C	G

A	I	B	F	A	E	D	F	C

G	A	H	G	F	G	I	G	C

B	G	F	B	A	F	E	C	G

I	B	C	B	F	E	D	E	C

D	E	C	B	F	I	B	A	D

A	B	C	H	C	E	A	D	C

I	G	C	A	D	B	O	A	E

STOP

Total ☐

A	B	C	D	E	F	G	H	I
8	5	2	6	3	1	9	4	7

G	A	D	E	A	B	C	A	I

G	I	D	A	B	A	D	B	H

B	C	H	G	A	I	H	G	H

G	B	I	E	A	B	G	C	B

I	C	B	E	C	G	F	B	G

I	G	D	C	E	F	E	G	D

H	I	F	H	I	C	C	B	E

G	C	B	E	B	A	B	I	G

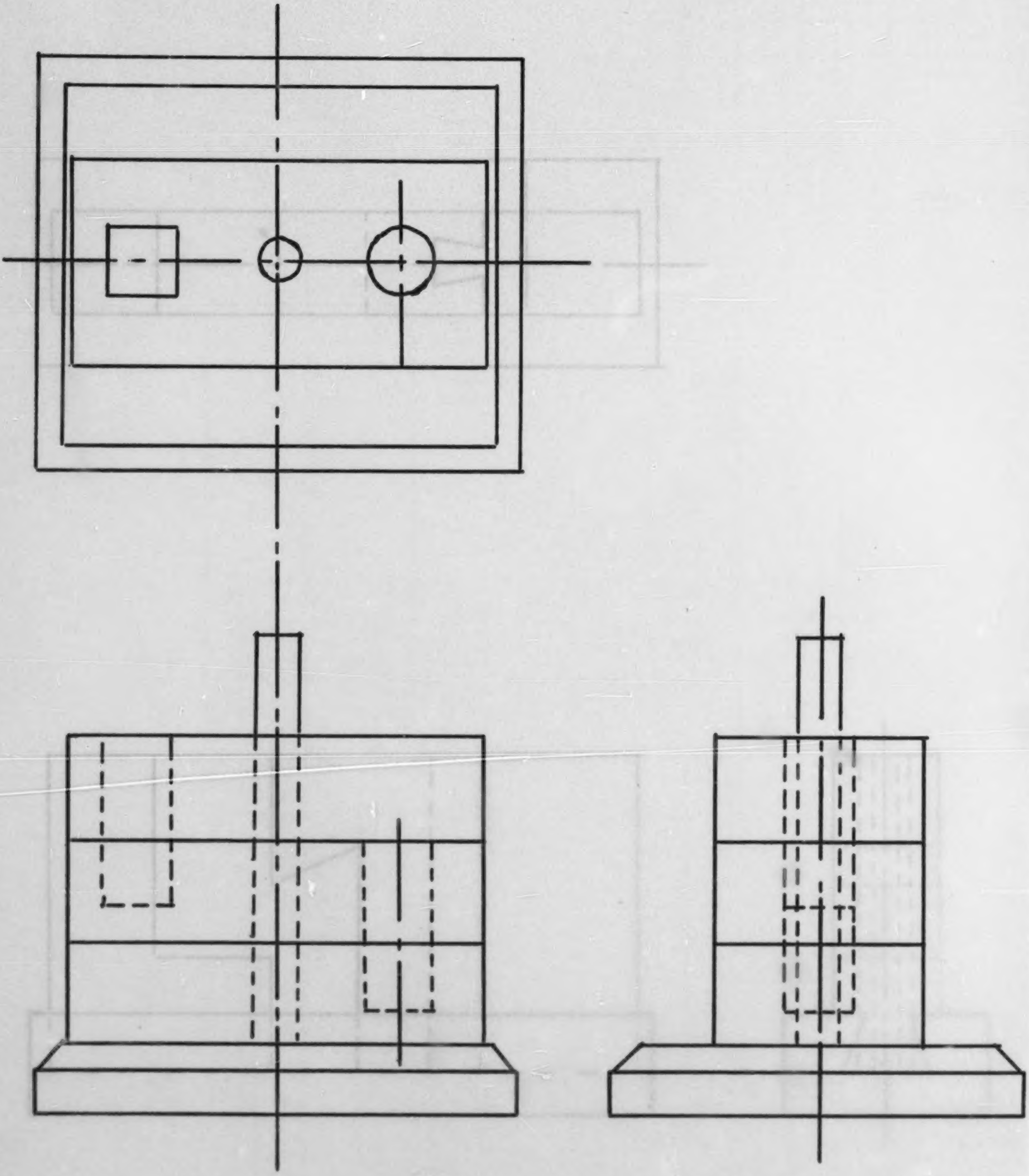
E	H	B	I	G	D	B	C	H

STOP

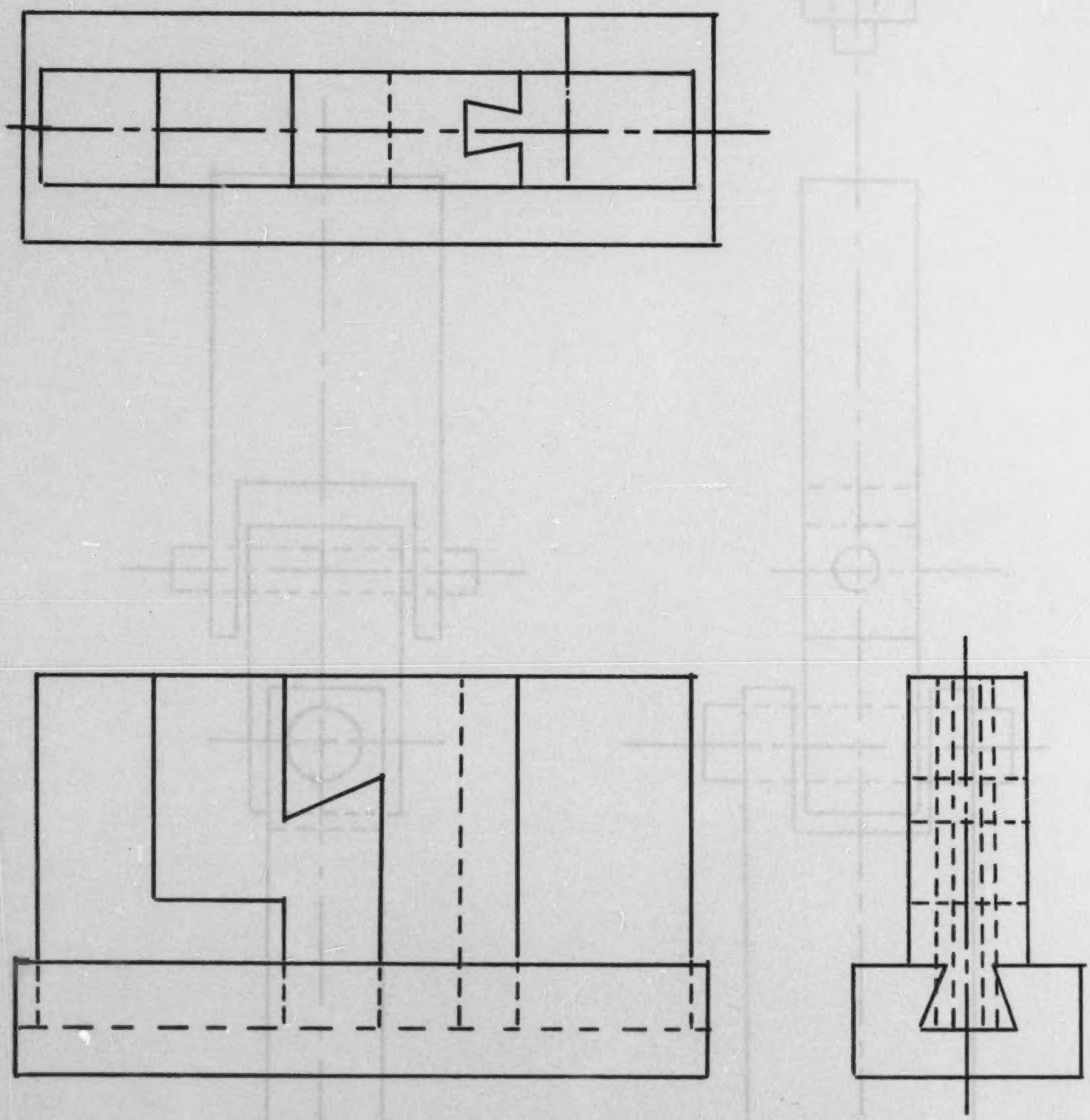
Total ☐

APPENDIX F

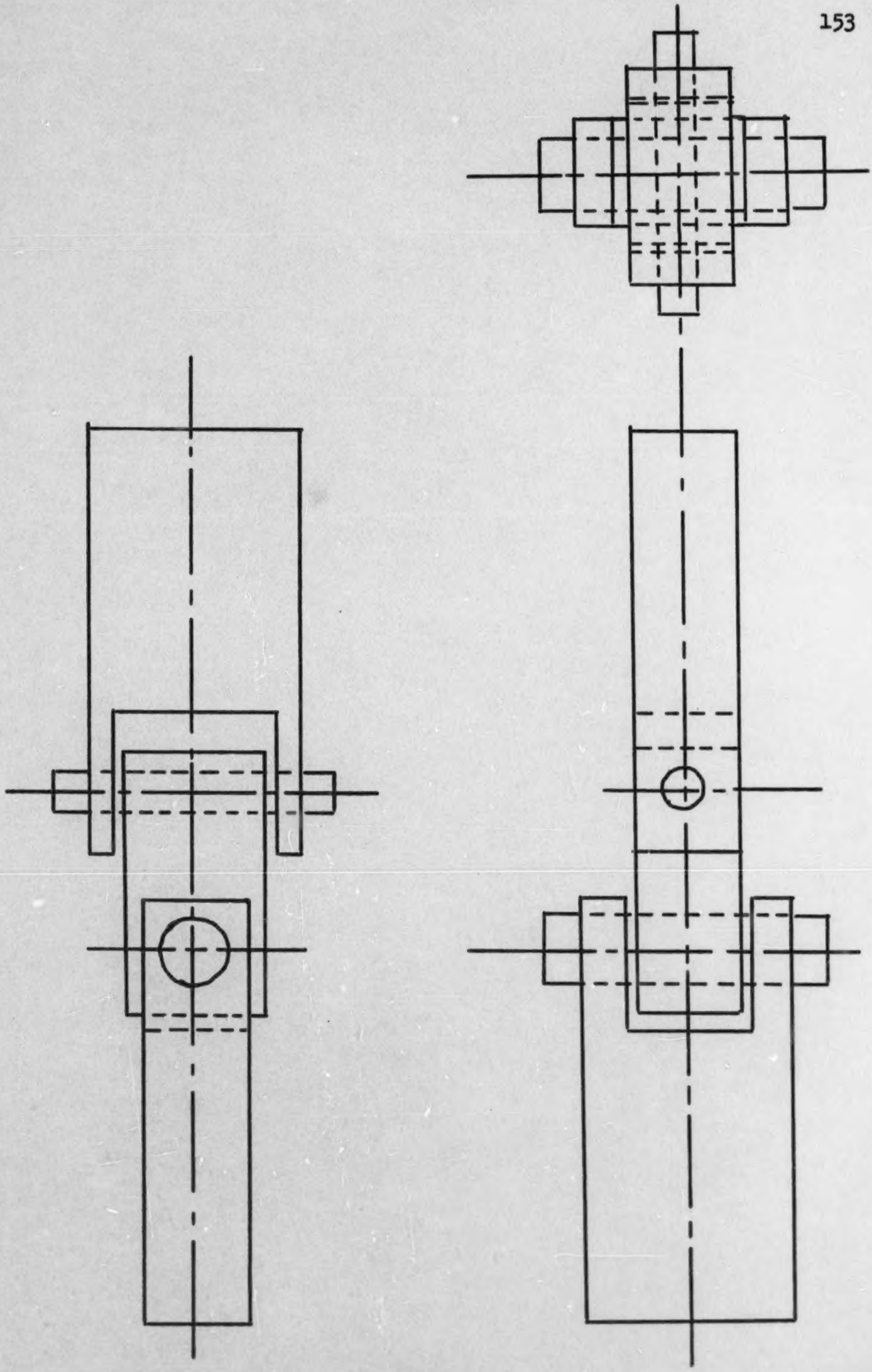
ASSEMBLY TESTS AND PRACTICE ITEMS



Assembly Test 1



Assembly Practice Item 1



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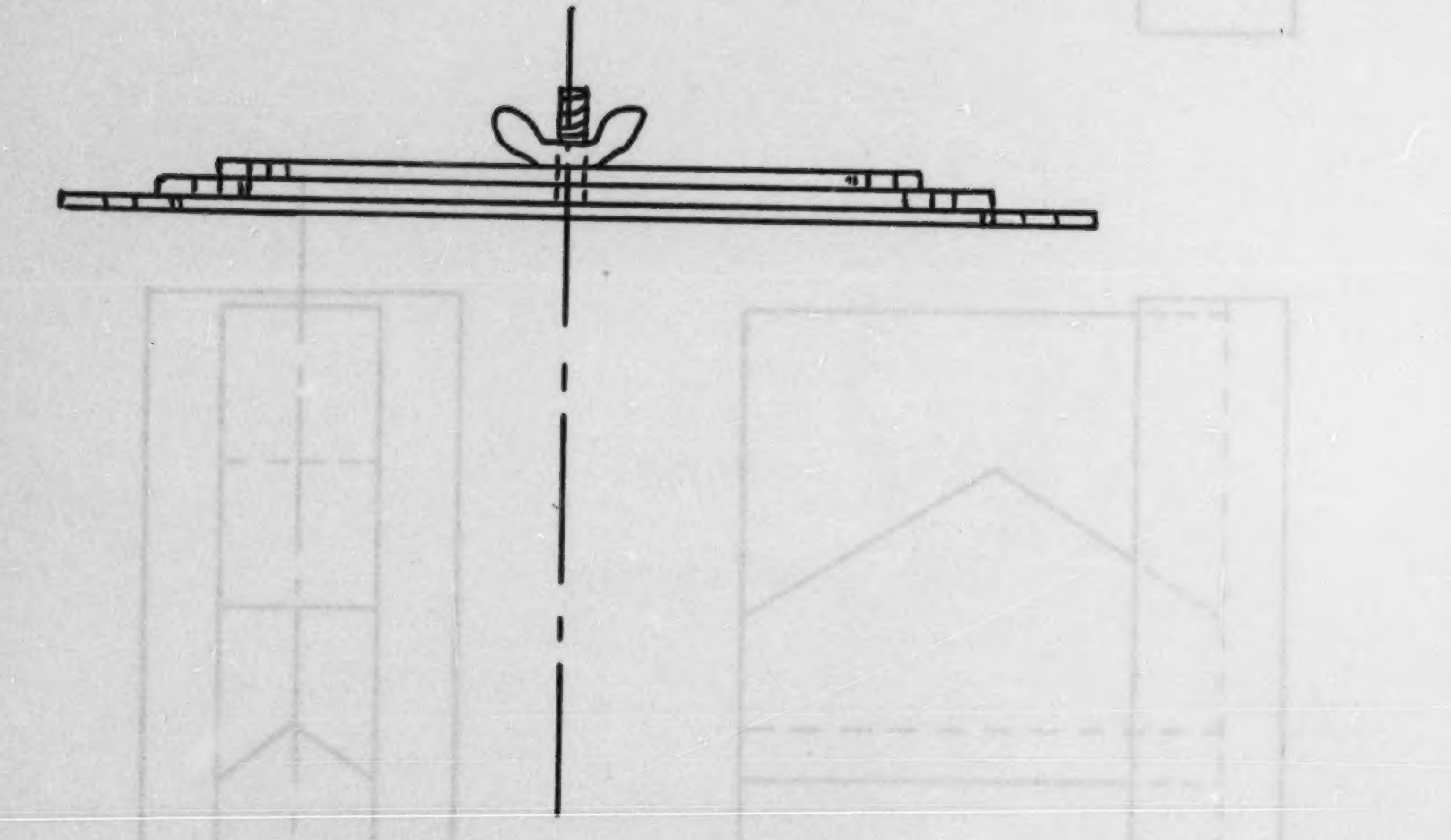

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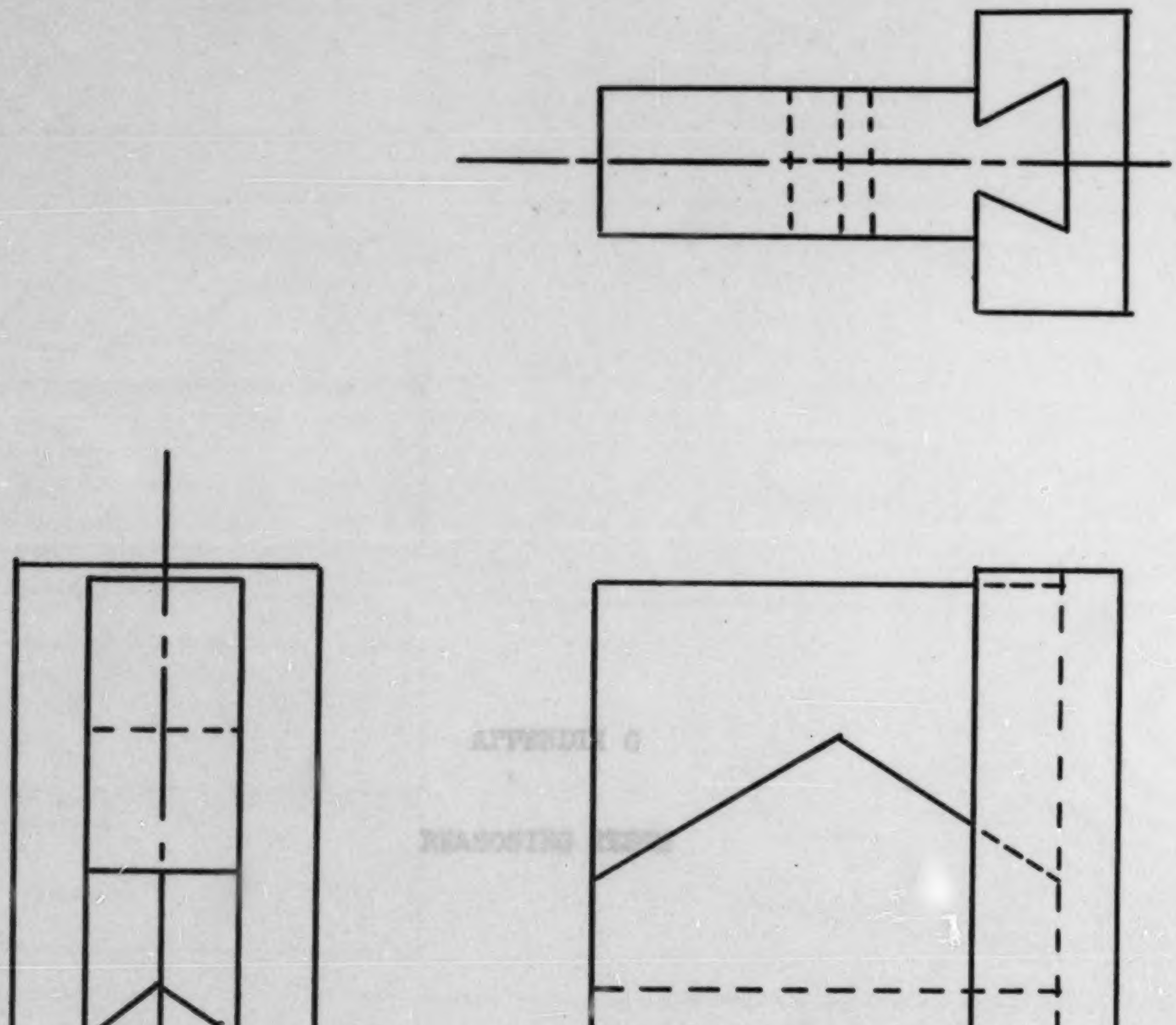

Assembly Test 2

APPENDIX G

REASONING TESTS

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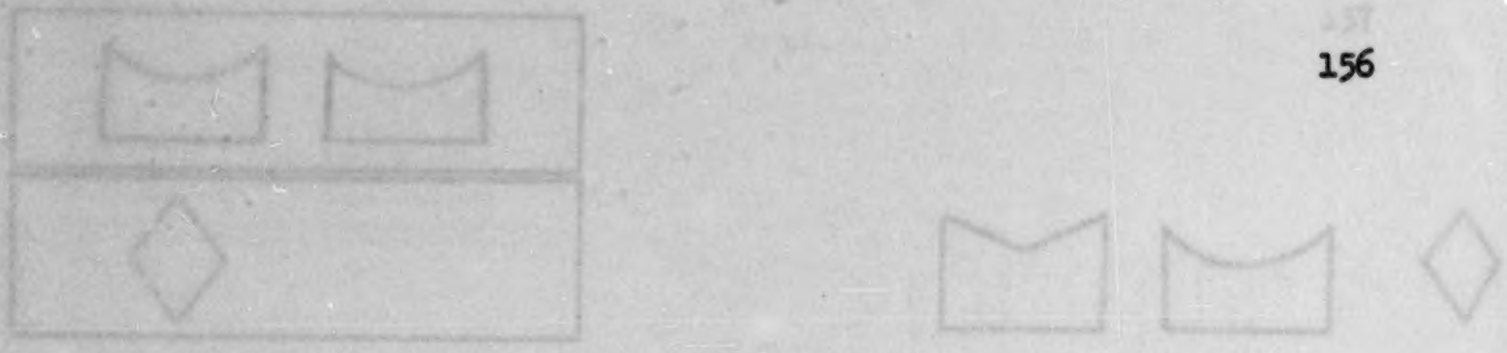

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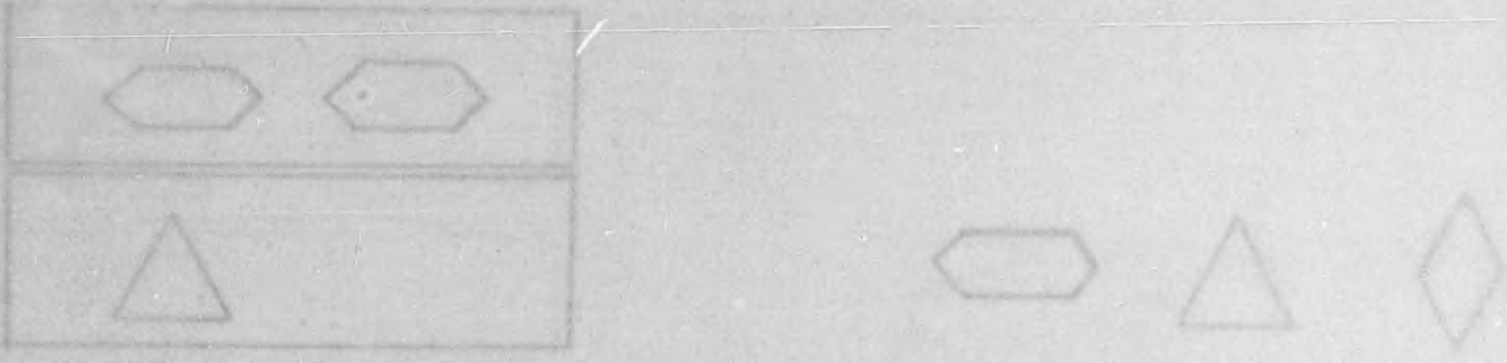

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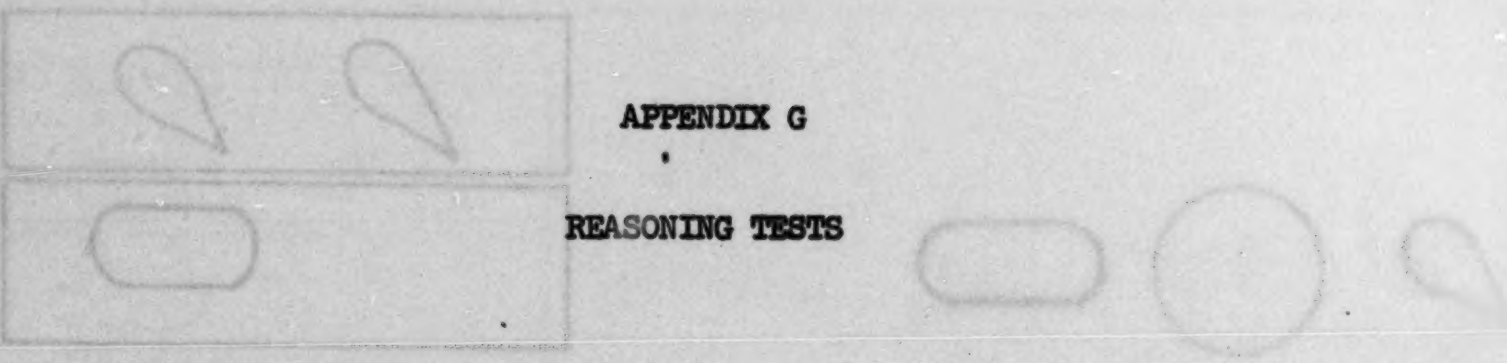

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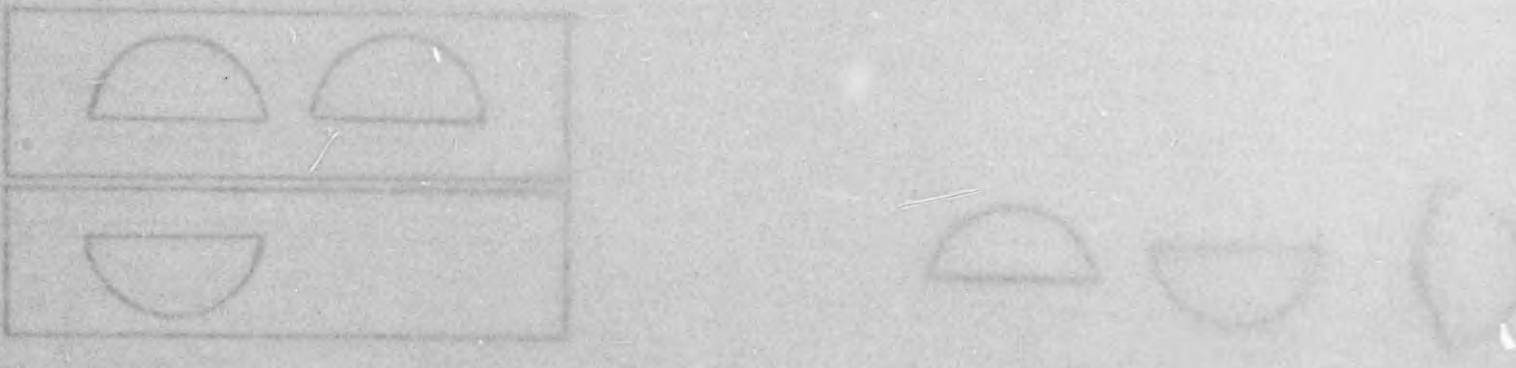

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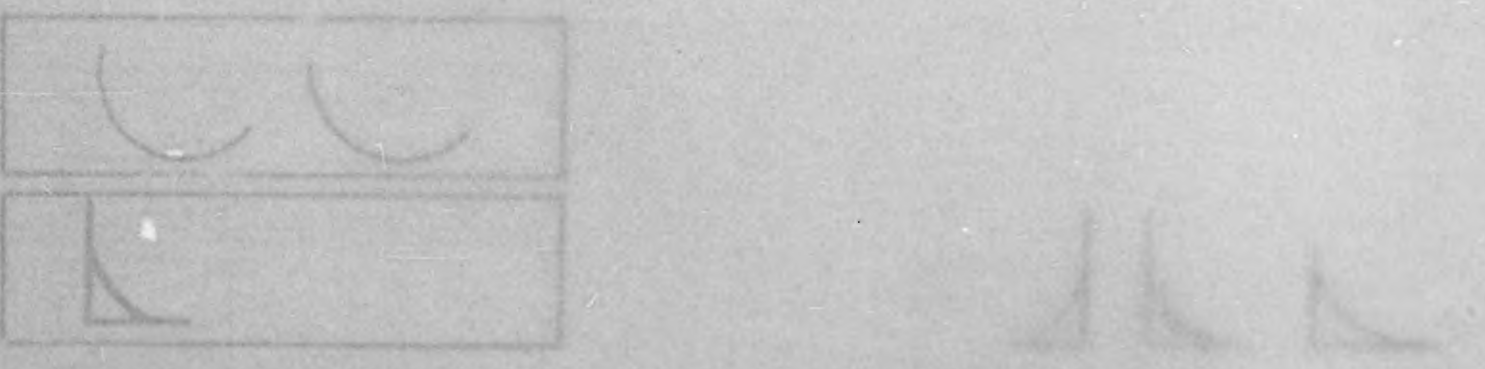

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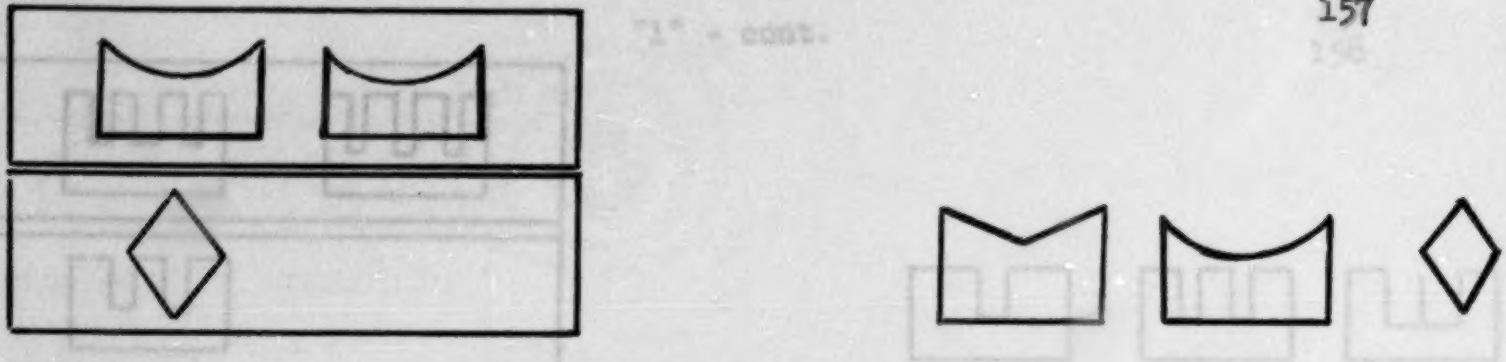

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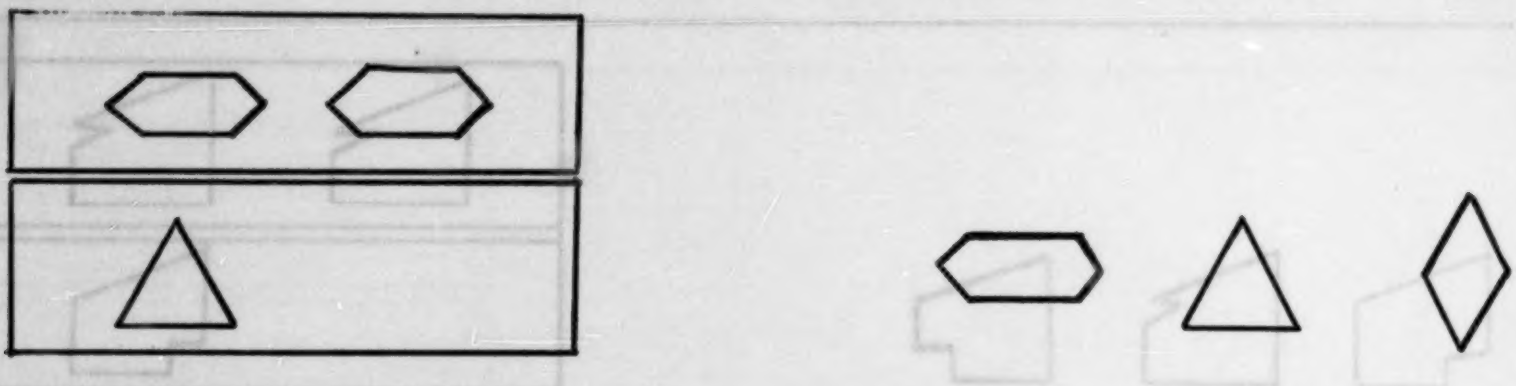

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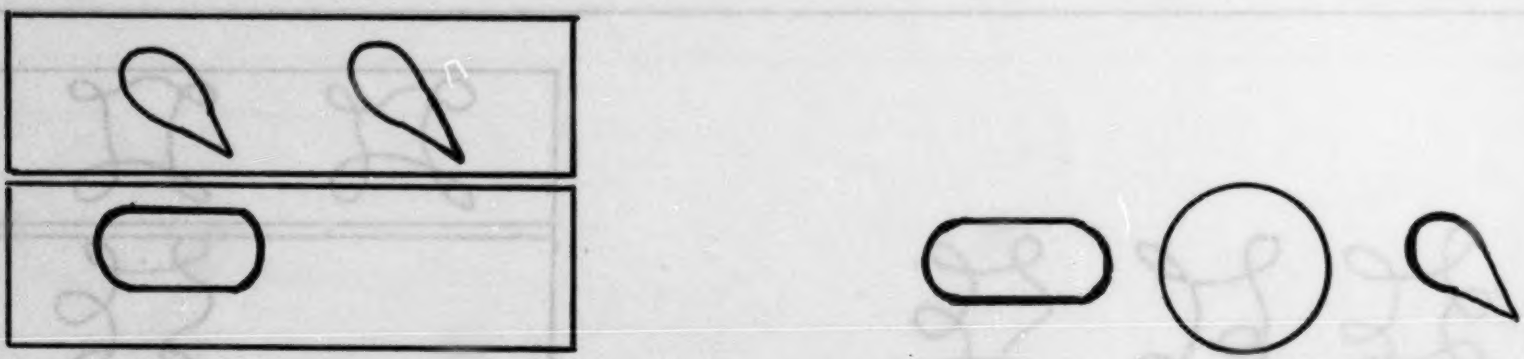

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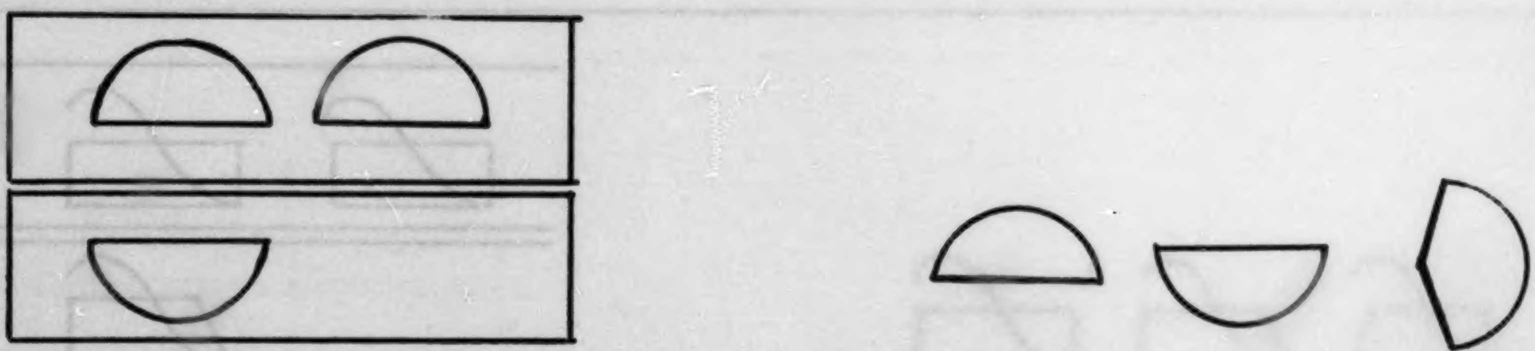

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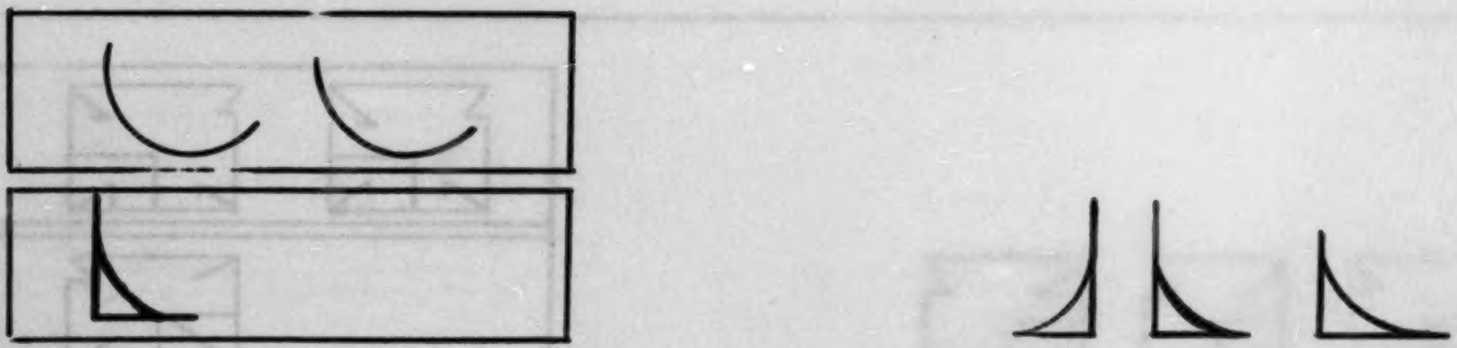

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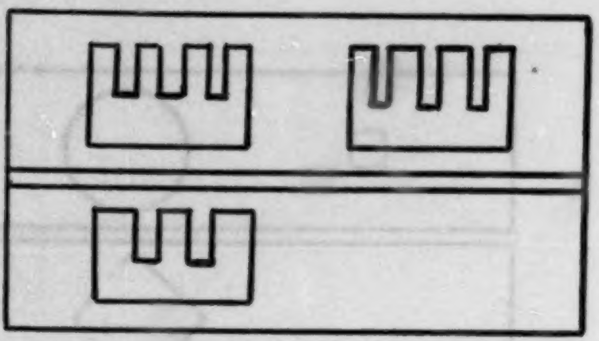

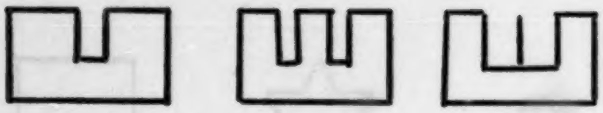

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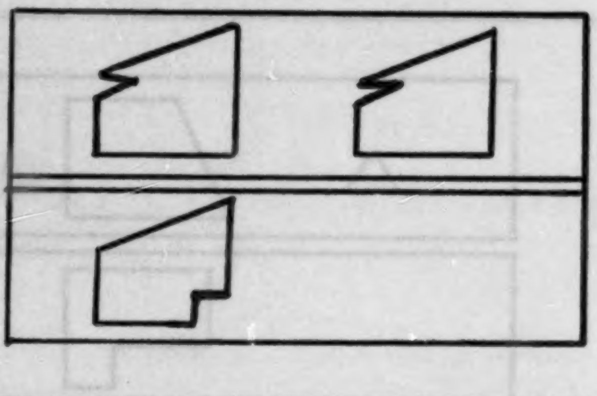

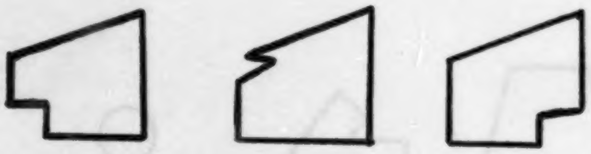

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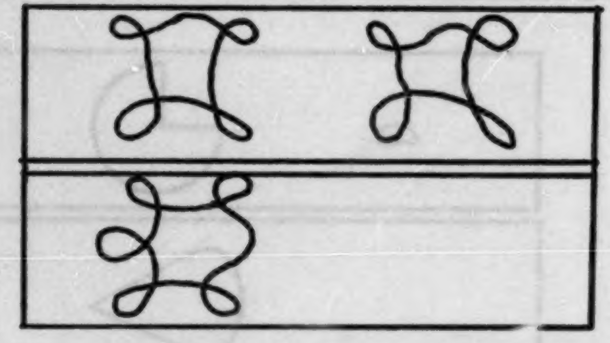

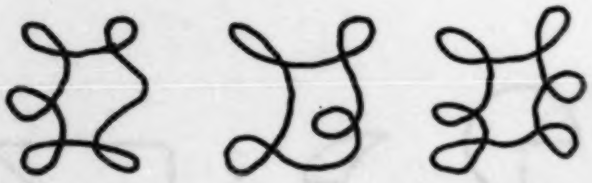

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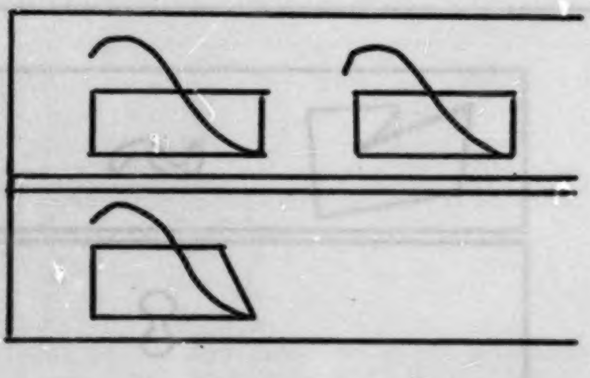

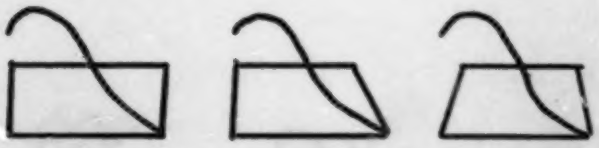

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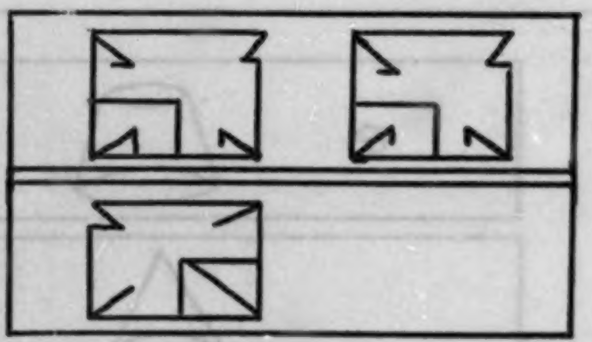

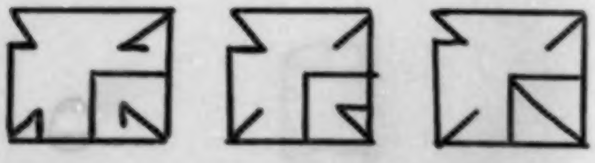

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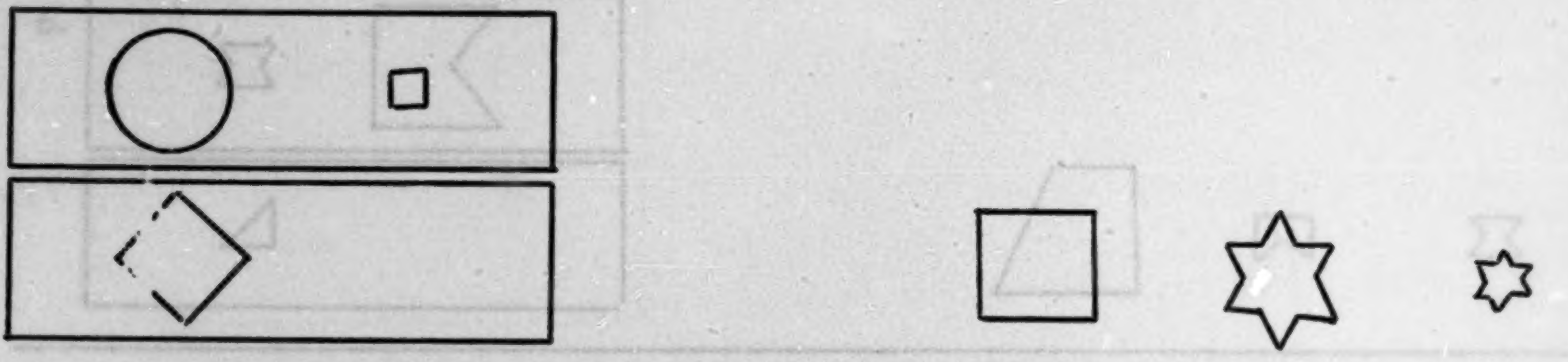

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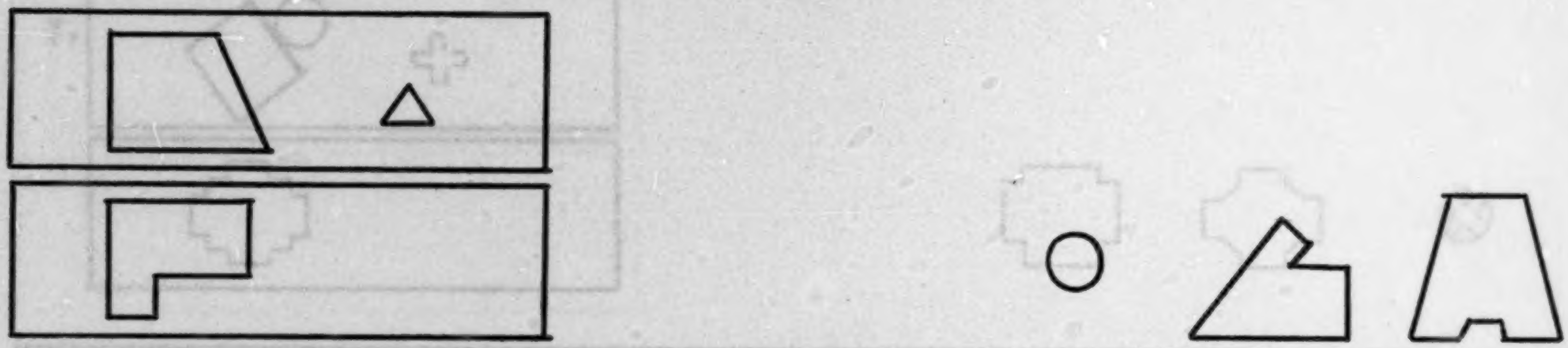

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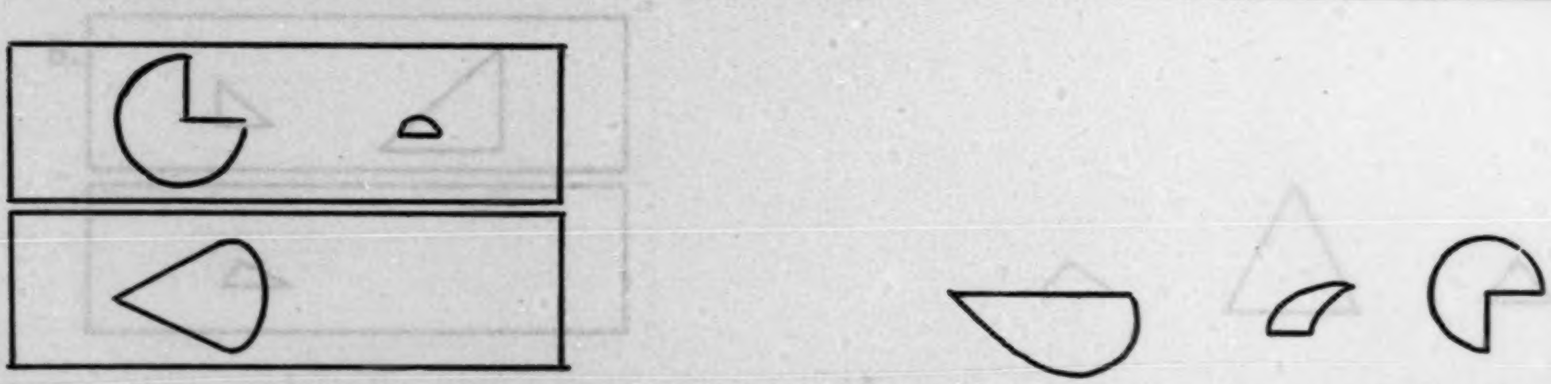

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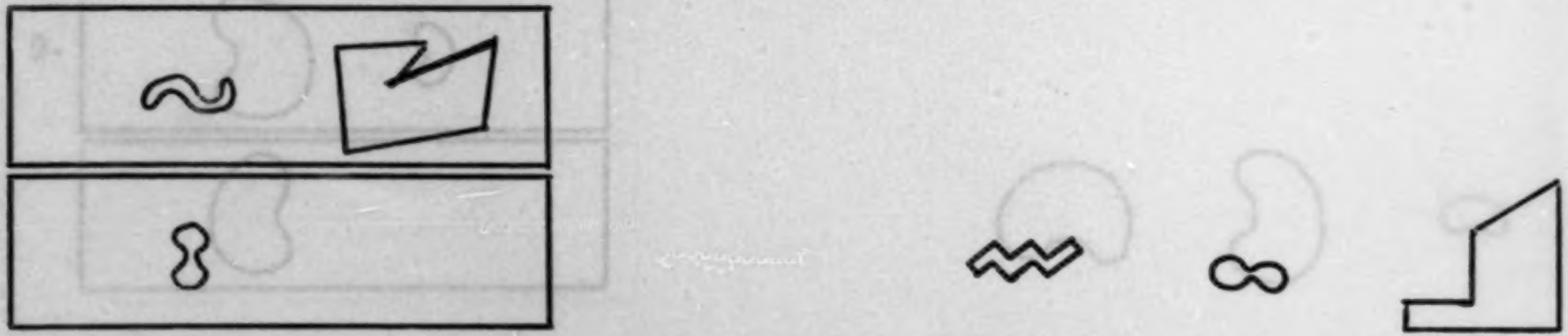

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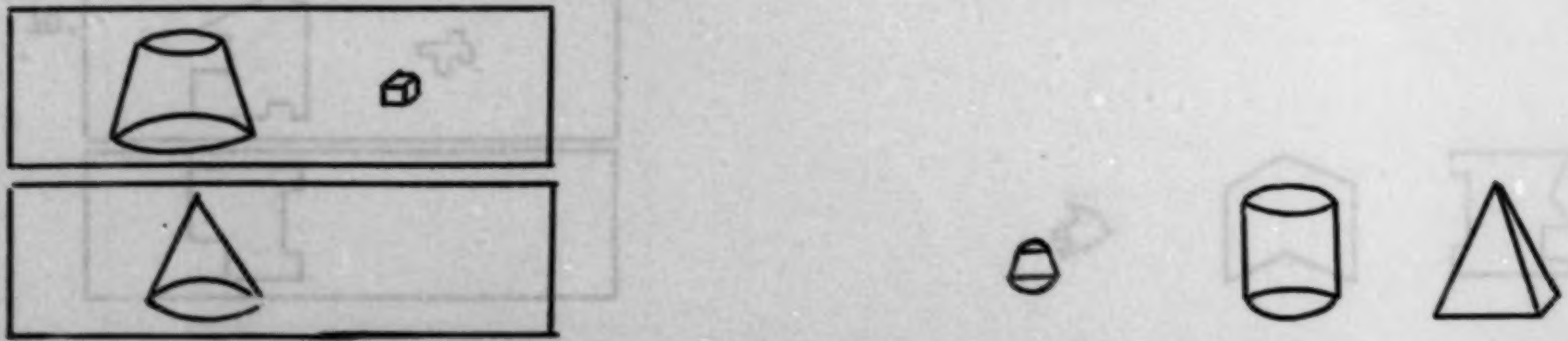

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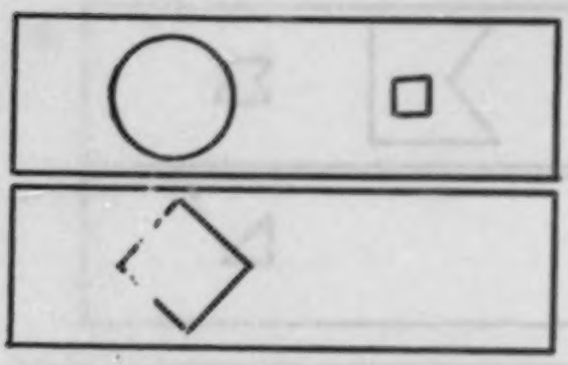

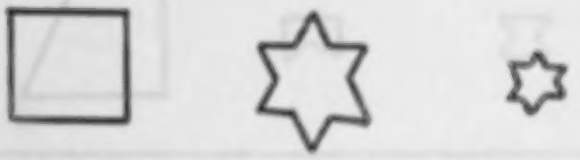

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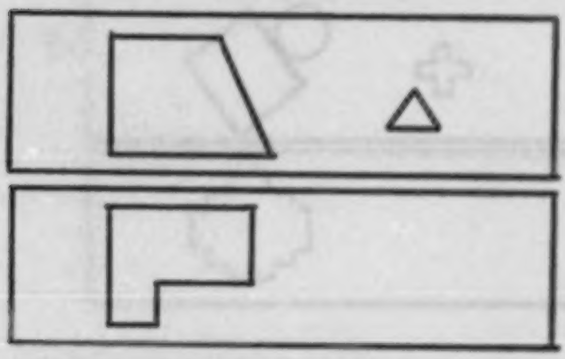

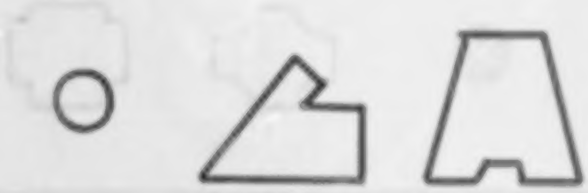

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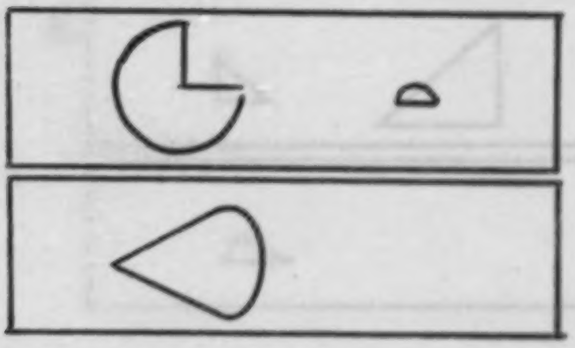

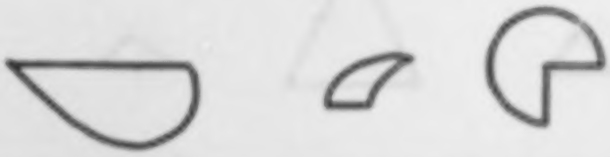

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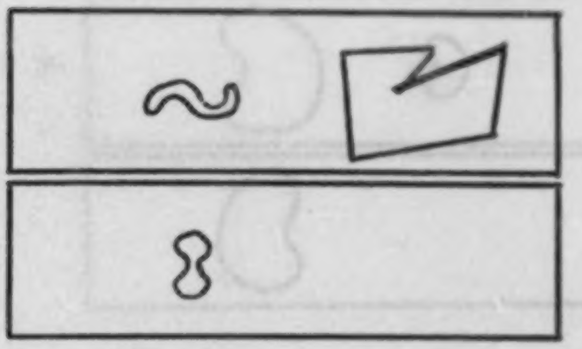

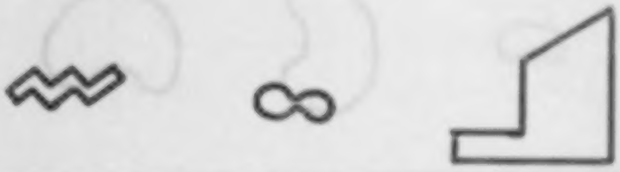

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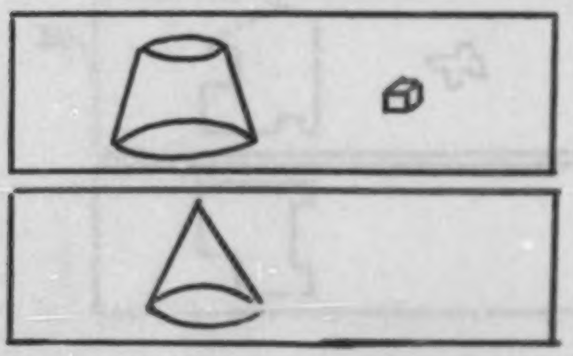

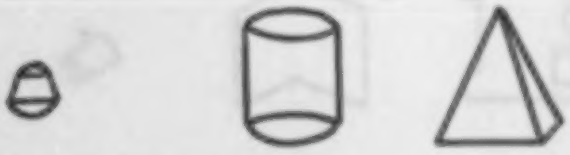

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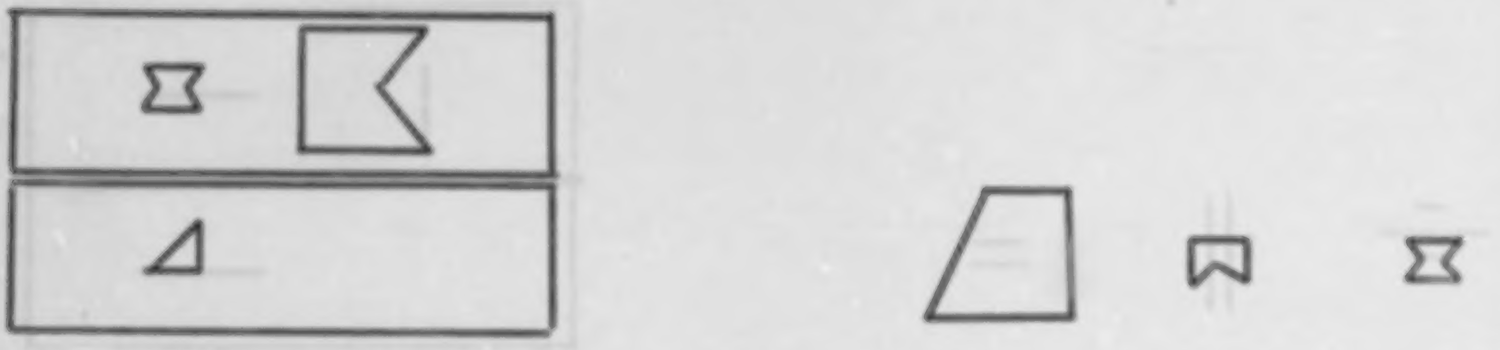

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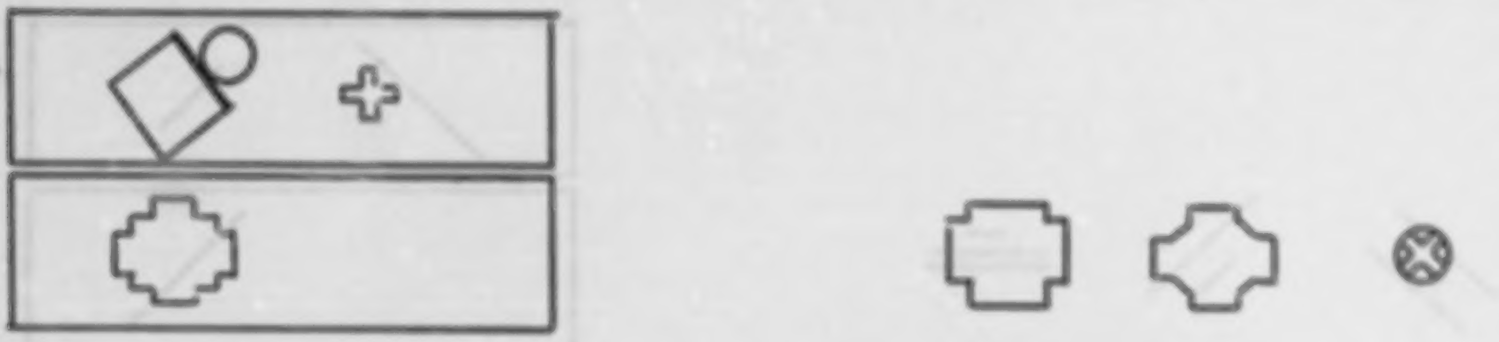

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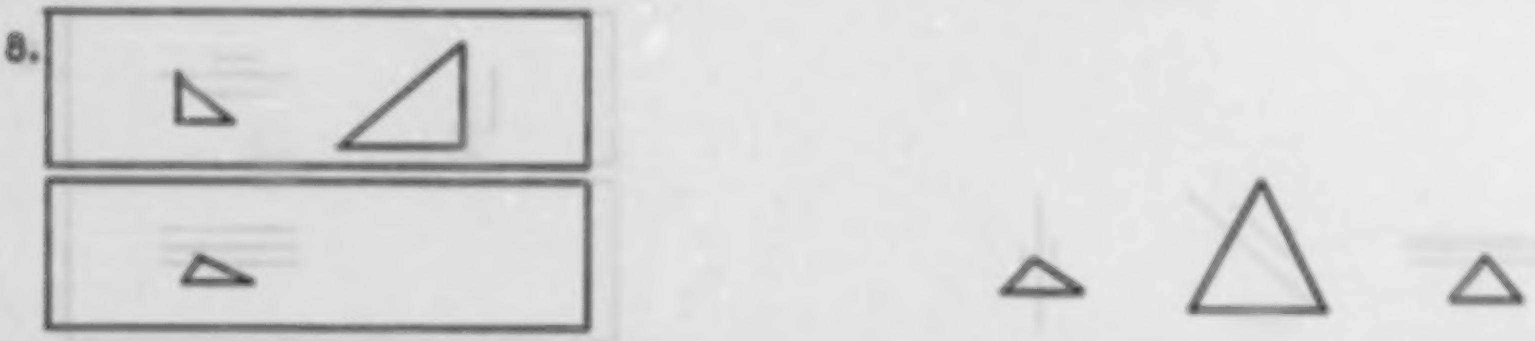

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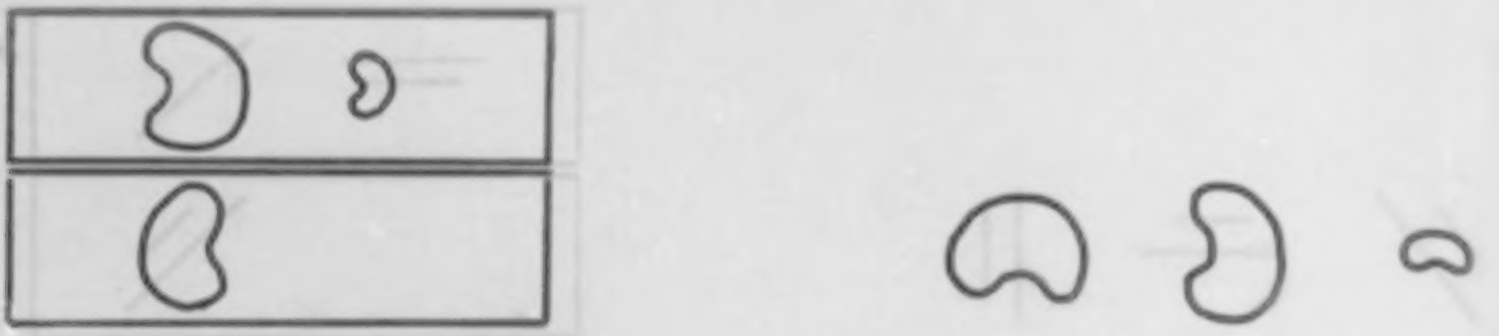

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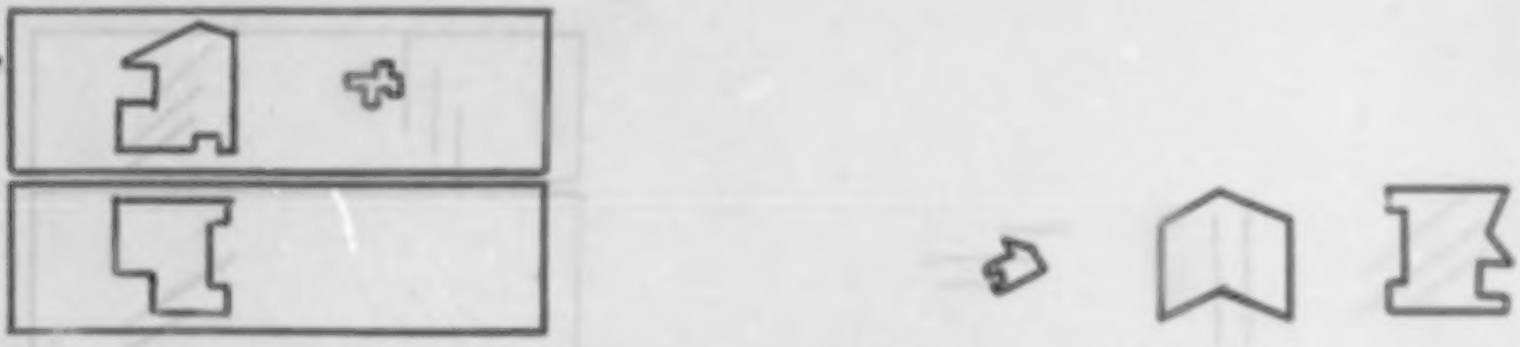

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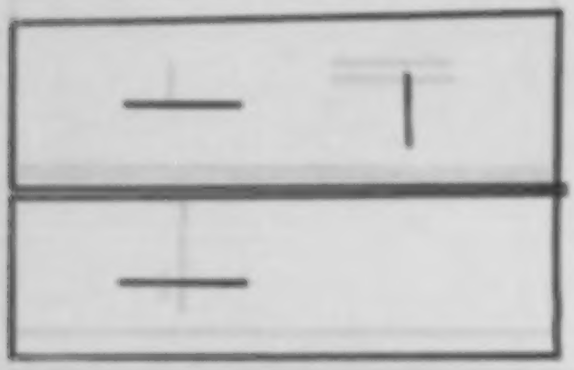

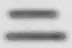

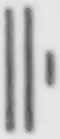

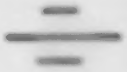

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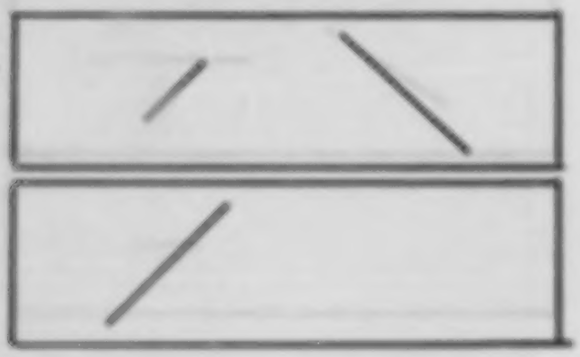

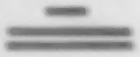

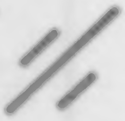

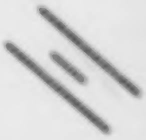

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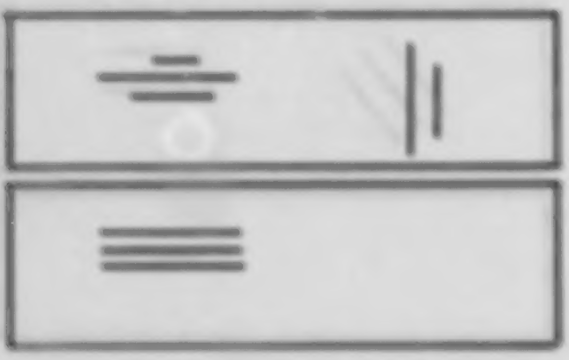

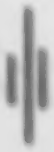

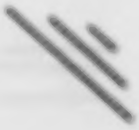

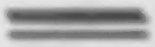

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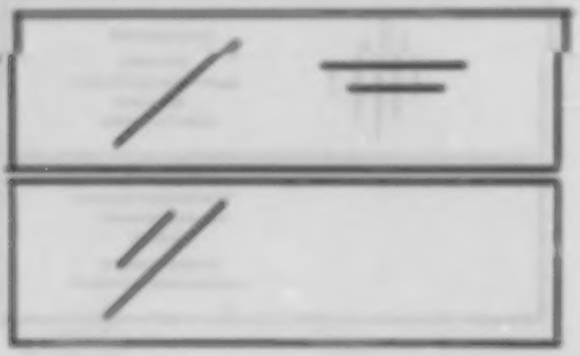

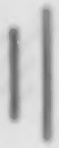

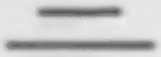

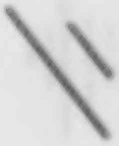

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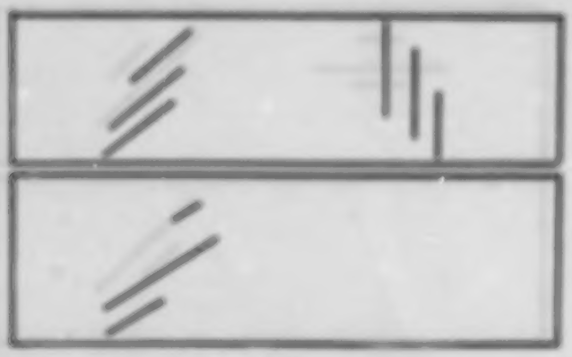

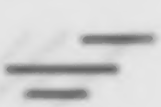

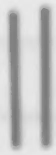

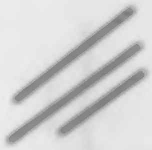

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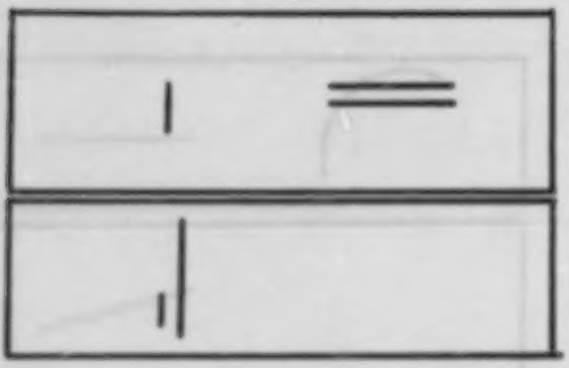

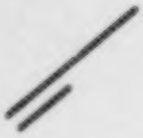

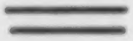

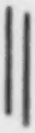

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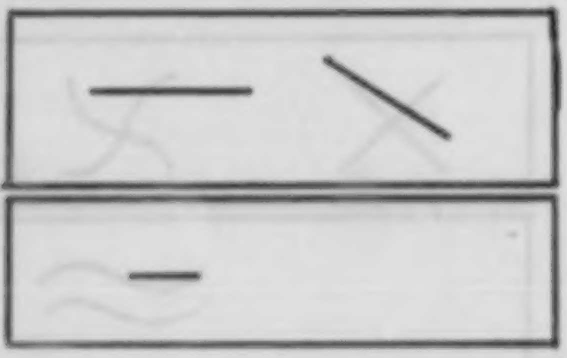

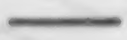

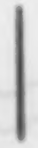

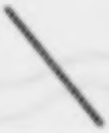

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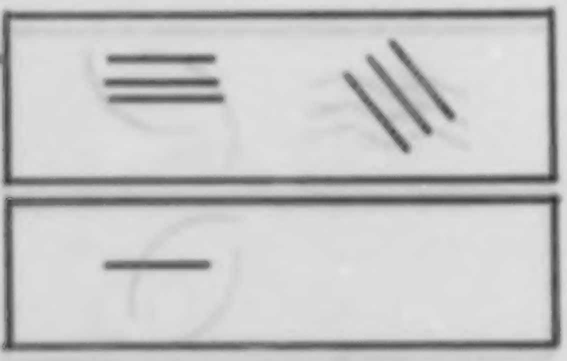

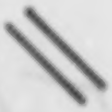

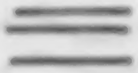

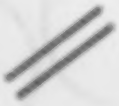

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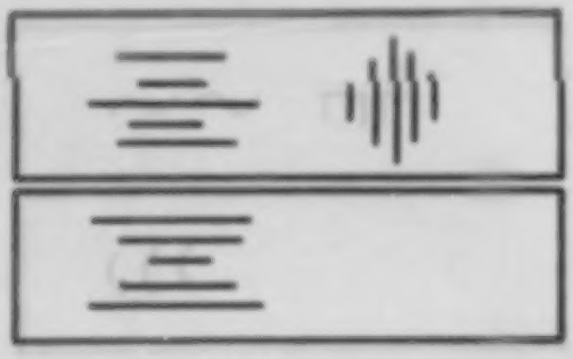

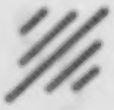

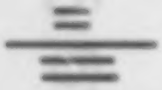

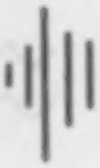

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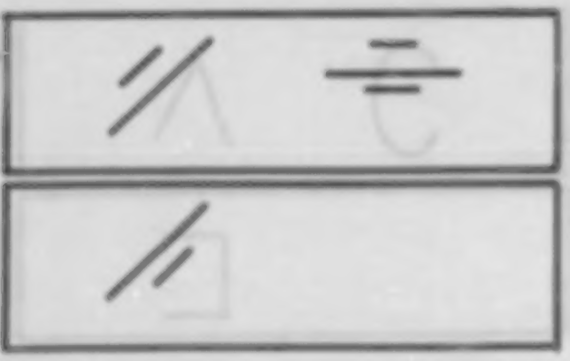

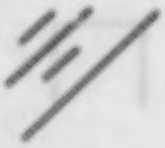

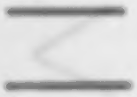

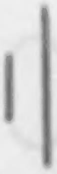

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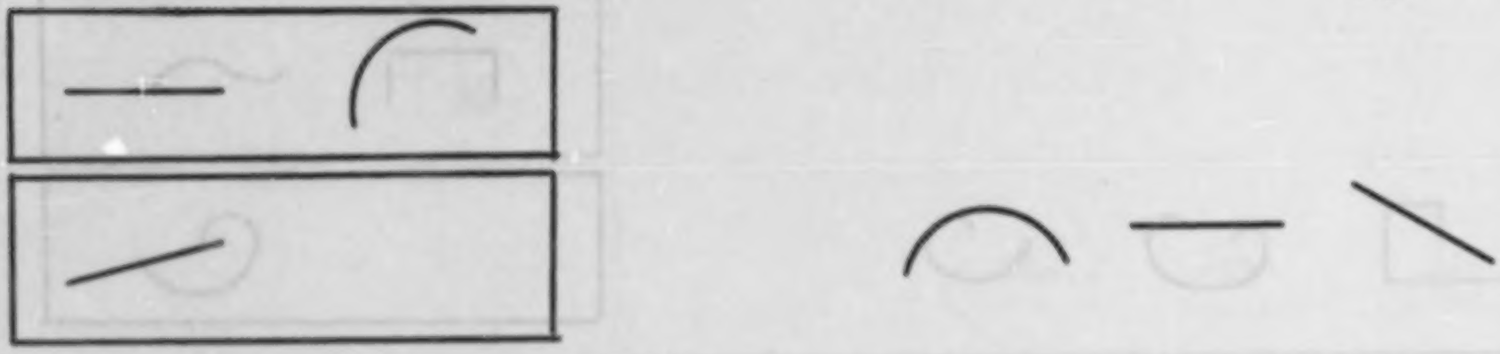

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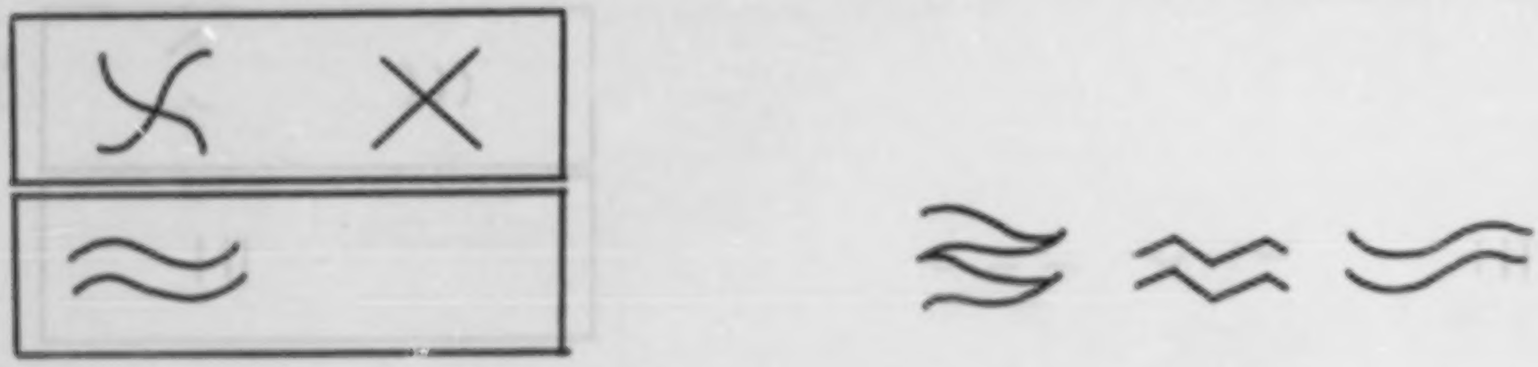

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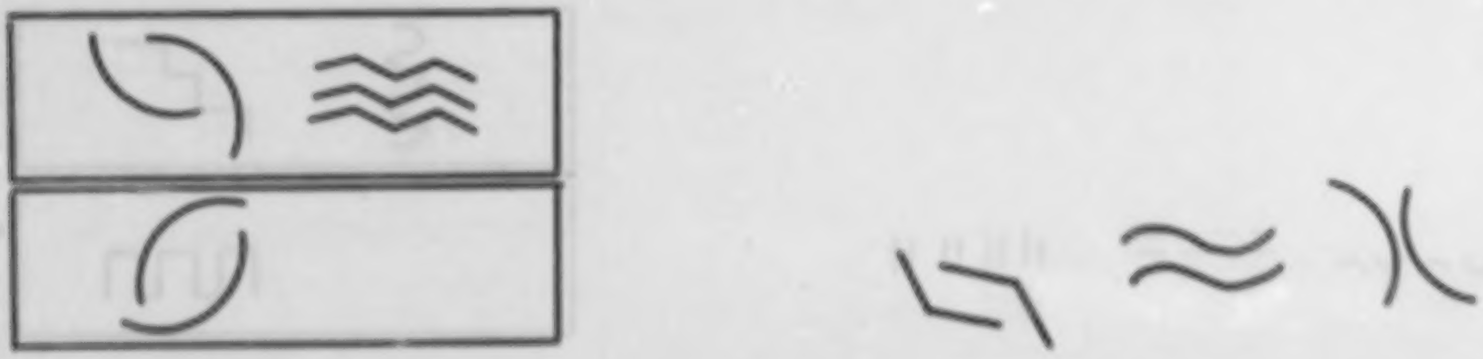

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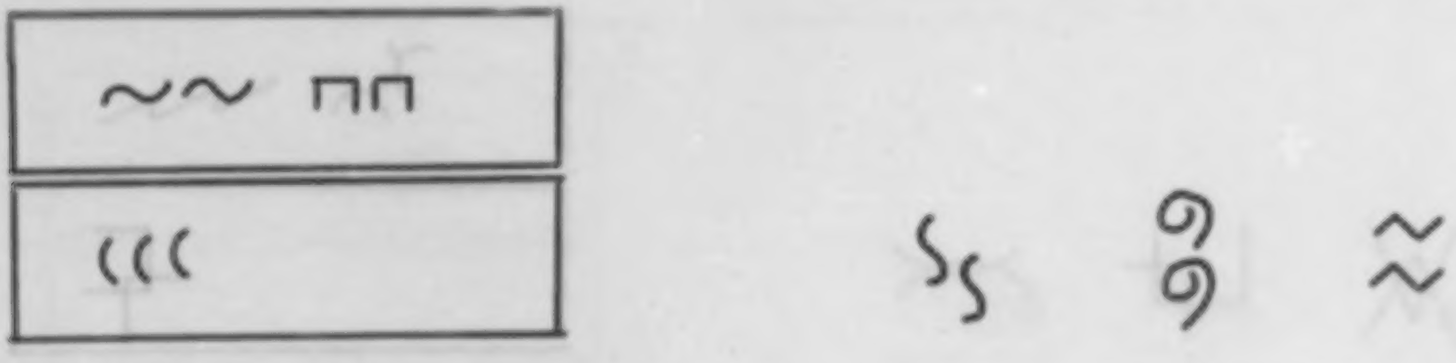

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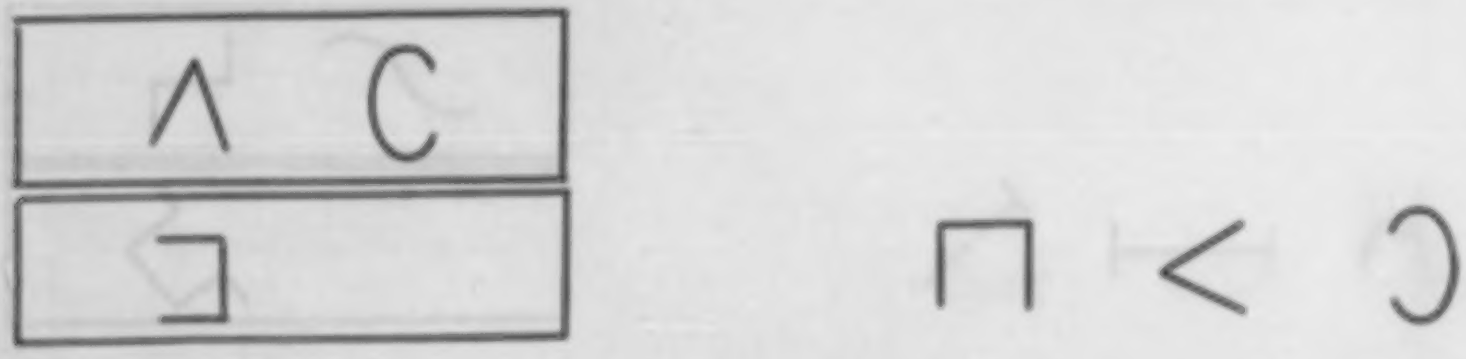

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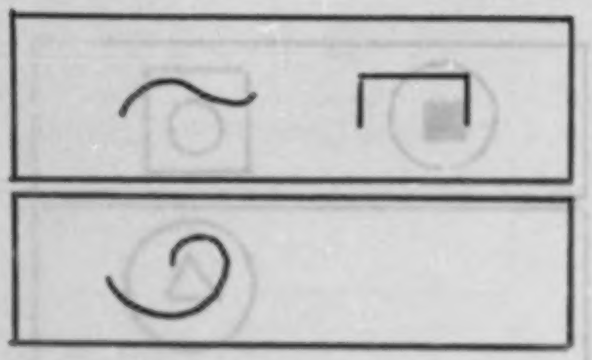

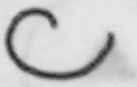

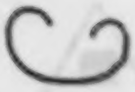

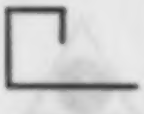

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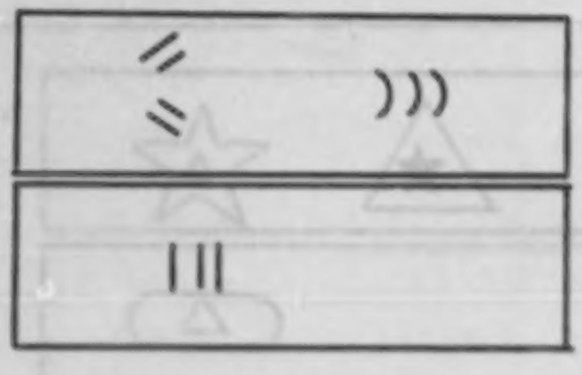

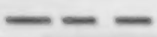

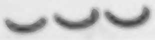

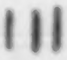

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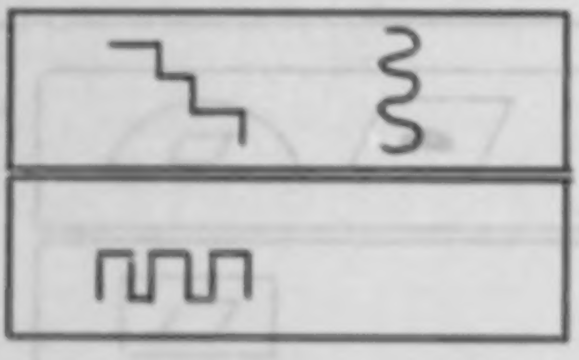

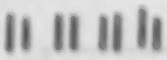

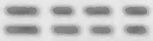

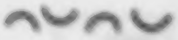

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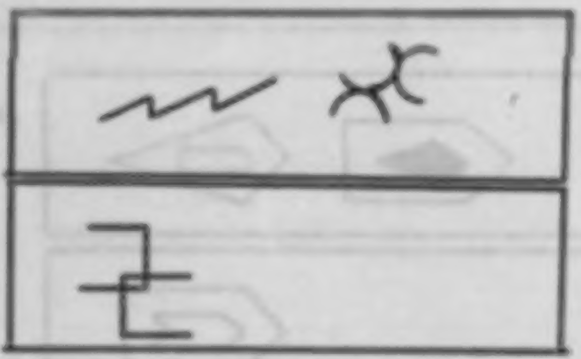

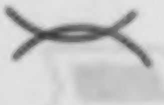

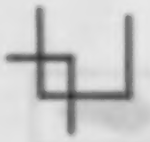

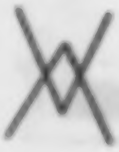

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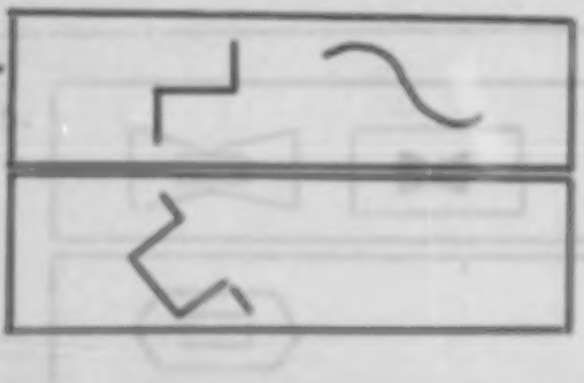

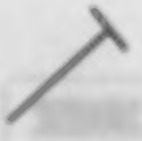

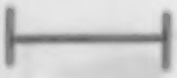

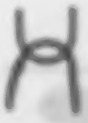

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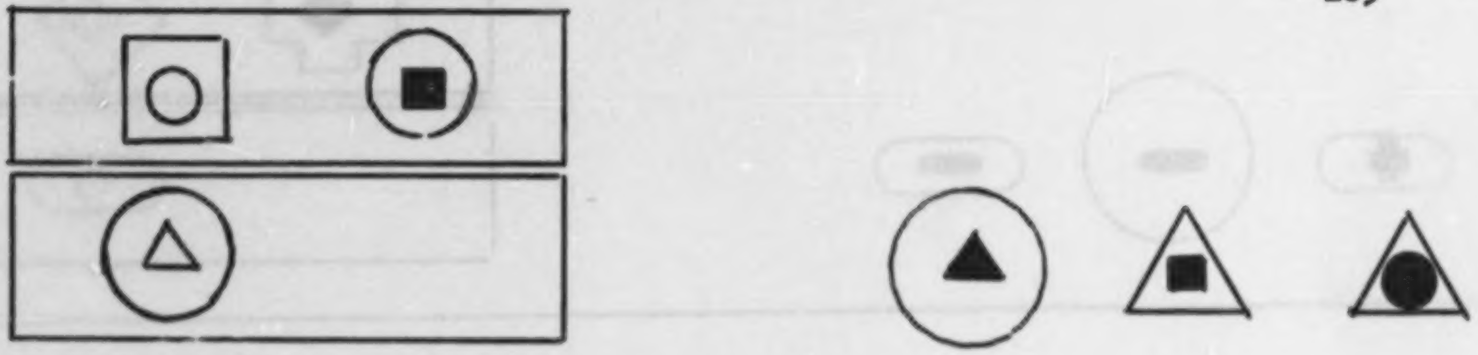

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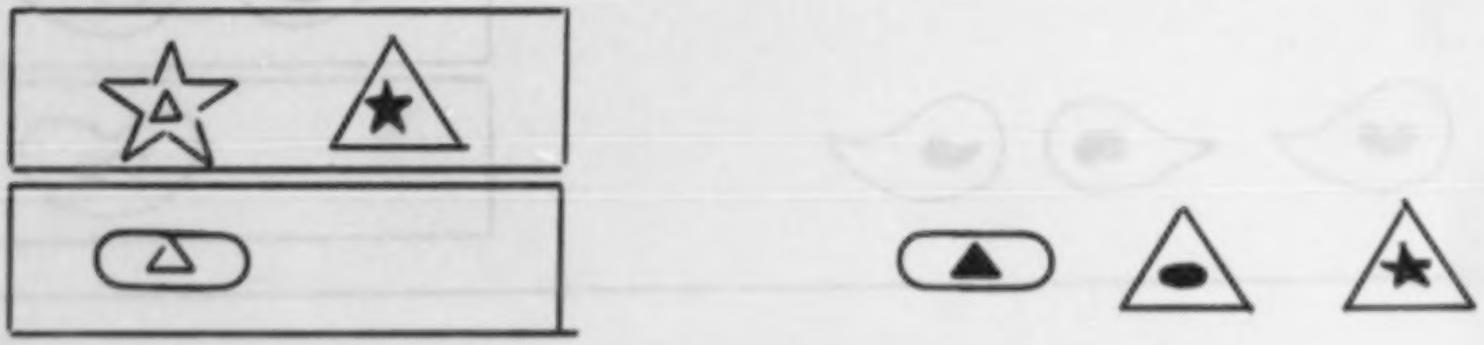

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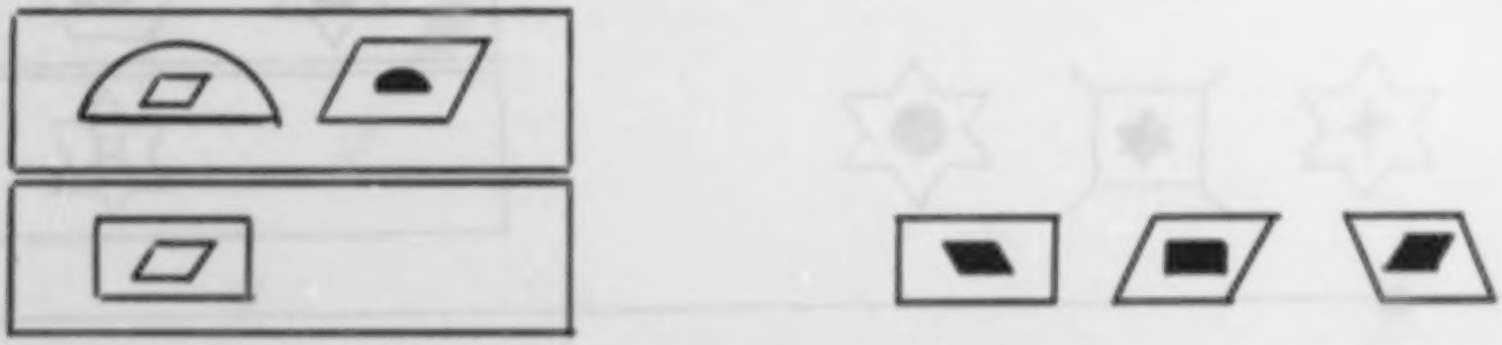

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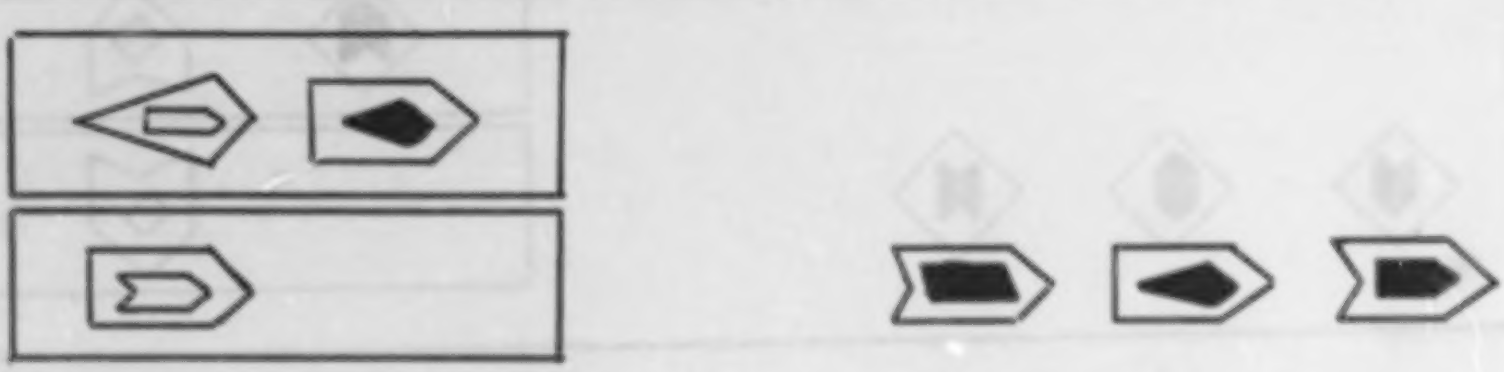

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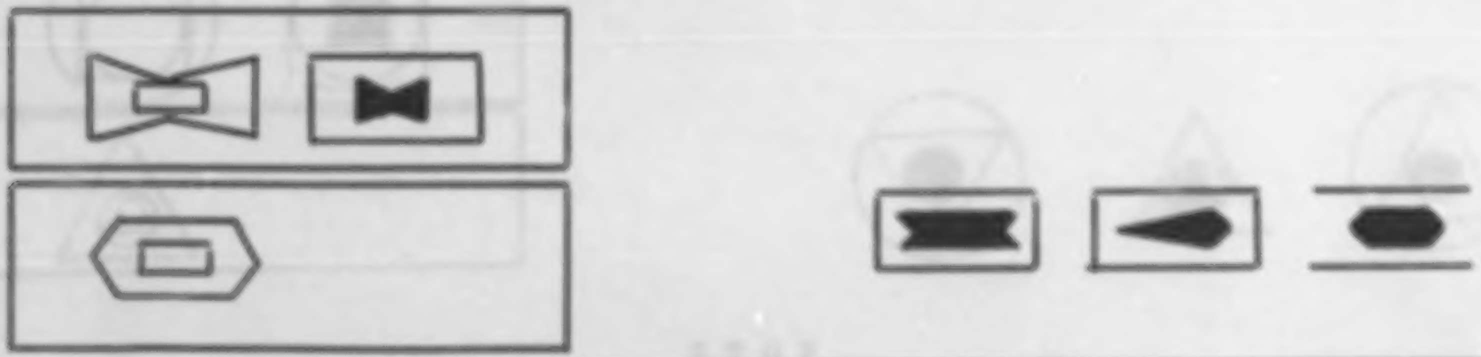

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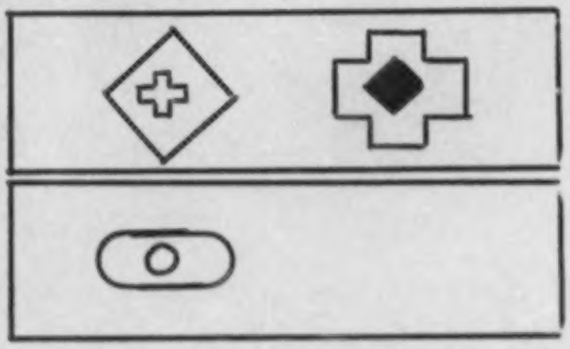

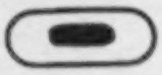

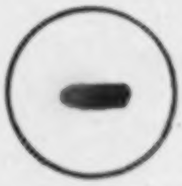

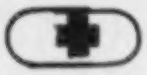

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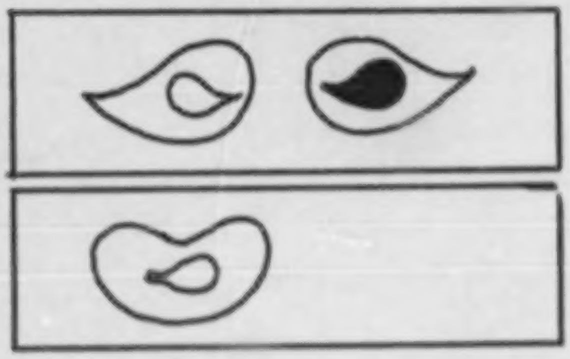

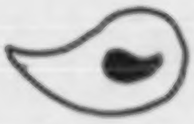

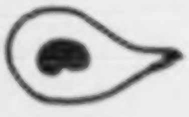

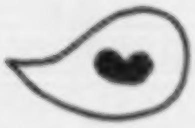

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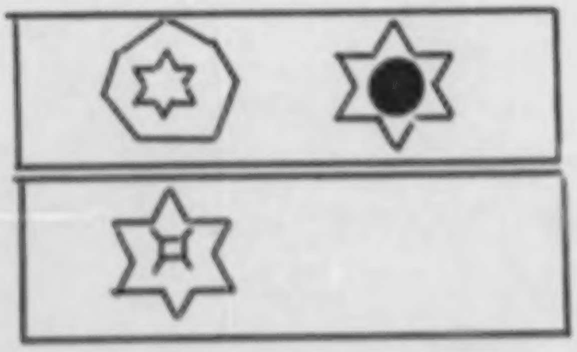

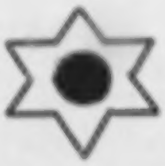

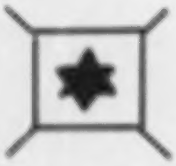

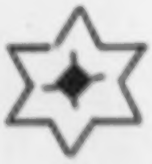

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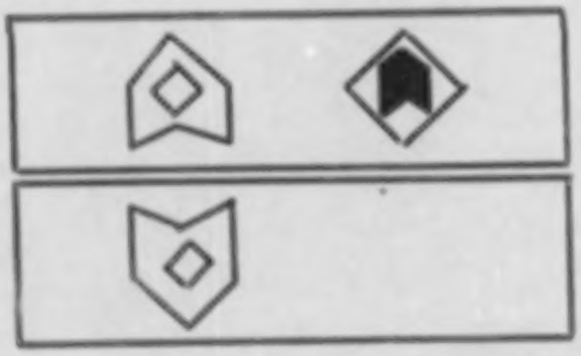

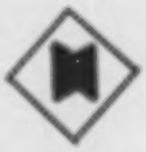

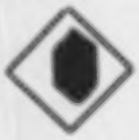

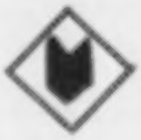

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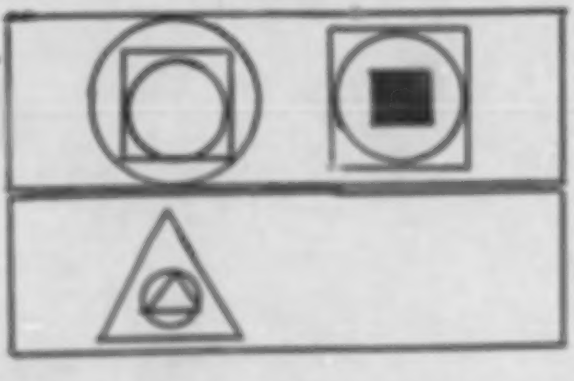

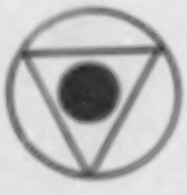

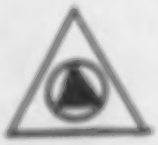

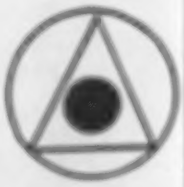

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